NUMERICAL METHODS TO EXPRESS LIFESPAN OF A BUILDING WITH RESPECT TO SEWAGE AND PIPING SYSTEM

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Abstract: The numerical methods known in our days proved to be very useful tools in approximating actual level of efforts. Most important factors that influence the level of efforts for structures can lead to irreversible changes in a structure behavior. Due to a high demand expressed by economical needs and high economical value of the structures there is a factor for risk that estimates the risk of failure for a construction structure. However this factor does not take in consideration any social aspects or economical aspects related to the length of a construction. The paper proposes a better factor to be implemented in order to better address the financial and economical needs for calculating the life of a construction. Due to the high value of a construction structure a factor that allows a better estimation of the length of a construction structure is needed in order to obtain reliable economical forecasts for future investments and business proposals. This paper proposes the implementation of an internet based data with complete information regarding the life of a construction structure. The paper proposes ways to introduce data in order to help the calculus the lifespan of a specific structure.

Key words: stiffness matrix; age level; numerical method; the age factor; semi probabilistic method; lifespan of a construction, sewage and piping system.

1. INTRODUCTION

The $\beta$ factor that is available based on semi probabilistic predictions is integrated in an algorithm that leads to a prediction based on some researches made by Lewin [5] in the last decade. I do believe that for buildings the factor $\beta$ that estimates the risk like the $\beta$ factor in other fields like economy is not significant in all cases.

The reason for $\beta$ factor not being significant in all cases is because there are cases when a structure becomes unusable not only in situations determined by the risk of collapse. Some RC structures are taken out of usage due to other reasons like old fashion architectural/technological, cracks in concrete or high risk for future collapse in the event of a seism. However, it is well known that in most cases, according to Beateley [2], the main cause for total collapse of the reinforced concrete structures is due to broken pipes or explosions due to gas pipes. The paper deals with a new proposed safety factor based on statistics with respect to connection between piping and safety of the reinforced concrete structure.

2. MAIN IDEA

The stages for the life of a building are: design, actual life and post-usage of a construction. Actual life can be considered
according to the safety factor $\beta$ considered as material strength over design stress and expressed in (fig. no. 1).

Main factors that influence $\beta$ factor, which estimates the risk factor are: temperature and fluctuations of temperature, initial Stress/strain due to small imperfections, chemical factors, especially corrosion of the concrete reinforcement, risk of collapse, degradation of the structure and risk of a seism. Please Note that some of the factors will not be treated here and that in some situations there might be some other significant other factors.

![Figure 1 - Safety factor graphic with respect to time](image)

The main factor that influences the ‘life’ of a building is obviously $\beta$ factor. $\beta$ factor is based on a semi-probabilistic theory. This theory is developed already and there is a computer based program that does this calculus mainly based as in (equation no. 1) [6].

$$\frac{R_r}{\psi_M} - \frac{S_r}{\psi_L} = R_c - S_c \geq 0$$

Where: $R_r$ - reference level for bearing capacity of the structure, calculated with characteristic values of material properties;
$S_r$ - Function that describes the reference level of normal load influences on the structure
$\psi_M$ - Partial safety factor for materials;
$\psi_L$ - Partial safety factor for loadings;
$R_c$ - Design value for bearing capacity of the structure;

$S_c$ – Design value for load;

This $\beta$ factor is of significant importance for economical purposes, but in current economic environment is not considered as the main factor that really matters for economical and financial purposes. Therefore better lifespan estimation $\alpha$ is proposed as in (2).

$$\alpha = n \cdot (\beta_1 \cdot \beta_2 \cdot \beta_3 \cdot \beta_4 \cdot \beta_5)$$

Where: $\alpha$ - represents the number of years predicted for a life of a structure,
$\beta_i$ - factors that influence the lifespan of the structure due to location/socio cultural or architectural /technological and economical aspects;
$n$ - usual time for a similar construction structure to be used.

Considering (2) for addressing economical aspect of the construction as Lewin [7] expressed:

$$C_{\text{Year}} = C_{\text{initial}} \left(1 + \frac{\text{Interest \%}}{12}\right)^n \frac{1}{\alpha} = C_{\text{initial}} + \text{Interest}$$

(3)

Where: $C_{\text{year}}$ - represents the annual cost for lifespan of a construction and $C_{\text{initial}}$ represents the initial investment.

In order to address the mathematical formulation (2) and (3) it is necessary to create data for evaluating factors as well as the factor $n$. This data can be created only through statistical data and currently such a data is not available in our country or elsewhere. On a contrary there is a data available in our country and most of the world regarding the value of the construction structure with respect to age and location of the construction structures. More over the data available in developed countries estimates the condition of the piping system only by subjective visual control. This data should be connected with data proposed in order to address the expected life of a construction.

As seen in (fig. no. 2) the life of a certain construction structure is influenced by
the way that the maintenance of the structure and piping/sewage system occurred.

Indicates the ideal curbe

Indicates a damage to structure due to piping system

Indicates a rehabilitation to structure

Indicates the curb with small repairs

Indicates the most common curb

Indicates the degradation level corresponding to ultimate state

Fig.2 Degradation level with respect to time

The paper will explain the connections among the curb expressed in (fig. no. 2) and will propose data to be implemented in order to better express these curbs in every specific case. The most factor that influences the life of a construction structure is the ideal curbe. More over the ideal curbe is a curbe that takes in consideration nothing but statistical data related to the safety usage of a construction structure. The most influential factors for curbes above are considered according to Tosa [11]: location, socio-cultural, architectural or purpose of the structure, technical environment factor and economic factor. However in some cases the most influential factor can become the factor influenced by the lifespan of the piping system, especially in structures that are designed for industrial processes.

Location can be crucial in influencing the life of it due to new trends of development of the area. Currently a great number of the structures(over 10000 units in Detroit according to Wall Street Journal) located in very dense population area with high economical interest are demolished due to the need of creating other facilities or construction structures. For expressing this trend a data can be created with good predictions over the length of the building from this point of view. Data proposed shows for every area the percentage of structure disaffected due to need of getting free that location.

As for architectural factor or purpose of construction structure a data with respect to these aspects is needed as well. Architects developed a scale to help express the architectural aspect of a structure. The scale proposed involves a 40% influence of the urban environment, 30% influence of interior design and 30 % influence of sustainability or friendly environment aspect.

The socio-cultural aspect is nevertheless one of the very important aspects that are neglected by economical forecasts and predictions. The life of a construction structure is greatly influenced by the social and cultural aspects of the structure.

Historical construction structures represent a special aspect, but there is no data to express the potential construction that will be historic structures. More over the curb from (fig. no. 2) that express the frequent and small repairs is changed dramatically, very often passing the ideal curbe. Never the less
construction structures with high social impact have a different curb for small and frequent repairs as well as the curb for major rehabilitation. These curbs are greatly influenced by the ownership of the structures and by the social impact of the structures. A new statistical data with these factors to be considered is needed in order to better address the mathematical formulation from (2).

The environment factor from technical point of view has been expressed previously by Dubina [4]. This factor refers to aspects like humidity, chemical environment, high seismic activity area and other technical aspects are part of the environment factor. For the statistical data proposed previously by Domsa and Catinas [3], a data with surrounding similar structures can be created and a local average safety factor $\beta$ can be divided by a national safety factor for similar structures and in that way a local safety factor can be expressed.

The economic factor is very important influence both the ideal curb of a structure and the small and major rehabilitation curb. The financial investment throughout the life of a building is influencing the small rehabilitation due to timely manner rehabilitation to be executed. As for major rehabilitation the time between a major rehabilitation and the moment this rehabilitation occurs is crucial due to possible extension of damages to the structure. More over the economic factor is important for expressing the quality of the work and materials spend in order to achieve the structure. Assuming that the amount of money spent and the total quality of the construction are interconnected a function can be created as well.

### 2.1. Analyze of the main idea

Factors like chemical factors, without corrosion due to humidity which is the most common can be estimated only statistically with very few exceptions. These exceptions require special case by case analyze and because those are very are cases I will not insist over those cases. There are theoretical known formulas of how the most important chemical factors influence the materials as expressed by Michael Fardis [8].

\[
C(x,t) = C_0 \left[ 1 - \operatorname{Erf} \left( \frac{x}{2\sqrt{D_c t}} \right) \right]
\]

Where $C_0$ = level of corrosion agent at surface of the element in percentage; $D_c$ - the diffusion factor with respect of the ratio $a/c$; $C(x,t)$ - level of the corrosion agent after a time $t$ of exposure (percentage); $D_c$ - the diffusion factor in concrete mass $(\text{mm}^2/\text{sec})$; $\operatorname{Erf}(z)$ - function that considers errors;

\[
D_c(t) = D_c0 D_1 t^{-1/10}
\]

Where $D_c0$ - the diffusion factor with respect of the ratio $a/c$;

$D_1$ - constant $=1$ for usual concrete;

$t$ - time of exposure;

Corrosion for the concrete reinforcement is a phenomenon that was of great interest for researches like Mircea Calin [9] from UTCN who made large studies for this matter, especially due to connection between thin reinforced concrete shells and this matter. In order to be very precise I would present a method by Iwanami [5].

\[
f_{a(p)c} = f_{a(p)c0} \left( 1 - 0.0132\Delta a_{a(p)} \right) \left[ \frac{N}{\text{mm}^2} \right]
\]

\[
E_s = E_{s0} \frac{1 - 0.0132\Delta \varepsilon_s}{1 - 0.01\Delta \varepsilon_s} \left[ \frac{N}{\text{mm}^2} \right]
\]

Where $f_{a(p)c}$, $f_{a(p)c0}$ - creep strength of reinforcement after and before corrosion;

$\Delta a_{a(p)}$ - thinning of the cross section of reinforcement in percentage;

$E_s$, $E_{s0}$ - elasticity module of reinforcement before and after corrosion.

This model is simple to use, but for the determination of $\Delta a_{a(p)}$ is required a test in site. Concrete humidity can be acclaimed.
with the absorption isotherms as Roelstra [10] suggested:

\[ w(T,H) = a_1 + a_2 T + a_3 H + a_4 T H + a_5 H^2 + a_6 T H^2 \]  

(8)

Where \( w \) - Concrete humidity (kg/m³);

\( T \) – temperature (Kalvin degrees);

\( H \) - macroscopic pores humidity.

Due to this valuable mathematical formulations expressed above is easy to conclude that a more realistic estimation can be made. In order to express the lifespan of a concrete structure is easy to create an mathematical algorithm that takes into account the possibilities that a certain damage to piping and sewage system occurs and the size of the damaged involved by such an event. Such a comparative estimation between the lifespan of a structure and the lifespan of the piping and sewage system is of crucial importance and can lead to valuable financial and economical forecasts. More over this system would benefit the contractors and small freelancers, the beneficiary of the construction structures as well as the government agencies and the general welfare. This internet application would create a triple win situation for government, contractors and beneficiaries of the construction structures. Moreover, another benefit would be due to high specialization class of small contractors and freelancers and the safety measures that would be strongly estimated and evaluated.

As for the cumulated error estimators can get greater attention through introduction of the present idea. The error introduced by estimators is as Amos [5] said in (9) and (10).

\[ e(x) = \theta(x) - \theta \]  

(9)

\[ d(x) = \theta(x) - E(\theta(X)) = \theta(X) - E(\theta) \]  

(10)

Where \( \hat{\theta} \) is the parameter being estimate and \( E(\hat{\theta}(X)) \) is the expected value of the estimator. Please note that the error, “\( e \)”, depends not only on the estimator (the estimation formula or procedure), but also on the sample.

Estimator engineers are engineers in charge with an estimation of the projects to be executed. The estimator engineers will have a greater implication by applying the present idea and their contribution should be linked to the estimators through trying to eliminate the errors margins as Amos [1] proposed in the mathematical formulation expressed by (11) that shows how far, on average, the collection of estimates are from the expected value of the estimates.

\[ var(\theta) = E(\theta - E(\theta))^2 \]  

(11)

Therefore an algorithm is proposed to a better prediction for the lifespan of a structure as seen above in (fig. no. 3) with the important note that this algorithm connects data from the structure capability to sustain with its piping and sewage system.

3. CONCLUSIONS

As expressed above a new data to be created is proposed in order to scientifically better express the lifespan of a construction structure. This estimation can be of crucial effect on economics predictions and forecasts. As known one of the main parts of the business is strictly related to cost of construction structure. Therefore a new data base is proposed to be created with dates related to architectural aspects, humidity aspects, location aspects and socio-cultural aspects as well. Once such a data is created is easy for engineers to scientifically estimate the length of a construction structure. Please note that a slightly differences in the example considered occurred of 1.11. That difference can be expressed further more in the post usage life of a structure as well as the ecological aspect. Furthermore the tax system that applies can dramatically be changed according to the life expectancy of a construction. The exact cost per year of a structure would affect the renting market as well by a better estimation of the business and a fair calculation of the profit margins.

We appreciate that a powerful tool that estimates the period of time for a concrete structure with respect to piping system incorporated to be used is a real benefit. The applications for such a versatile tool are obviously due to a better forecast and
prediction in an industry that generates yearly over 350 billion dollars worldwide according to IMF (International Monetary fund).

Fig. 3 Algorithm proposed in order to express the lifespan of a structure with respect to sewerage and piping system

We are currently working on a computer based application based on similar algorithms. We do believe that through this proposed method we can deliver a better answer to our research goals.

The differences among traditional safety factor estimation and proposed safety factor can be expressed further more in the post usage life of a structure as well as the ecological aspect. Furthermore the tax system that applies can dramatically be changed according to the life expectancy of a construction. The exact cost per year of a structure would affect the renting market as well by a better estimation of the business and a fair calculation of the profit margins.

References
LINIAR ANALYSE VERSUS NONLINIAR ANALYSE FOR SEWAGE AND PIPING SYSTEM

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Abstract: Numerical methods known in our days in order to address the calculus for a building structure involves the nonlinear calculus. Nonlinear calculus is basically a repetition of the linear calculus until a certain sectional equilibrium is acquired. Nevertheless a calculus that involves the stiffness matrix is also an approach often used in such a problem. As for the sewage and piping system is needed a calculus within the limits of linear limits. More often the need for a better approximation of phenomena that take place in the piping system is needed due to the fact that reliable and sustainable piping and sewage system are a great demand. More over I would say that piping is a crucial factor in some cases like fire or seismic event. For this purpose the present paper will consider some of the main important techniques for express the sectional and global equilibrium and stability. This paper will make a comparative analyze for the most important techniques with comparative results. The results are relevant in order to address the problem for further estimation and in order to address new challenges like ways and methods to compute errors of execution, seismic movements and aging/degradation or malfunctions of the piping system.

Key words: stiffness matrix; sewage and piping system; numerical method; the age factor;, sewage and piping system; comparative study.

1. INTRODUCTION

The paper deals with the non-linear techniques used in structural analyses for reinforced concrete structures as well as metal/other material structures. The techniques will show the numerical comparative analyze and will focus on the matrix stiffness method due to possible advantages that this method can bring. More over the study will express the Finite element method and techniques to address a non linear analyze by using linear analyze that is most convenient and implies the less amount of calculus. The volume of calculus needed for a non linear analyze will be an important issue treated by the present due to precision needed.

For further estimation of the sectional efforts that take place into the solids analyzed I will express the mathematical formulation for the stiffness matrix with 1 and 3 degrees of freedom. Also an analyze of compounding the final stiffness matrix is expressed in the present paper for the stiffness matrix with 6 degrees of freedom. In the end an algorithm will be propose capable of implementing this techniques that leads to good results comparative with laboratory tests. Please note that such an algorithm was tested for structural elements only as for sewage and piping elements it is only at an early stage.
2. MAIN IDEA

There are two major ways to estimate the cross sectional effort for a piping line/connection. This sectional effort, as expressed by Zienkiewicz [10] leads to the estimation of the minimal material/with and physical properties necessary in order to create a sustainable piping/sewage line. Most of the piping available on the market is certified through laboratory tests conducted by INCCD (National Institute of Certified Testing and Accreditations) in Romania and elsewhere by similar institutions. The main problem remains the viability, the time testing of the products; which cannot be tested on usually laboratory tests. Therefore some of the leading industry players offer warranties long periods of time. Even though the warranty is due, in fact the warranty cannot cover collateral damages caused by the degradation of other goods and values caused by a malfunction of a piping/sewage system. Often times the collateral damage is more significant in financial terms. That is why the study is a financial demand and the behavior of piping system is crucial in order to estimate reliable economical forecasts.

Next I will mention the Finite Element Method and the Matrix Method as main important ways to do the static and dynamic predictions, as expressed by A. Borosnyoi [2]. Because the topic is vast I will focus on Matrix Method. For an easy understanding of the matter I will express the Direct Method, which is characterized as Matrix Method, for a solid with 2 DOF (Degrees of Freedom), as expressed by Faur [4], as seen in (fig. no. 1).

![Figure 1](image-url)

**Figure 1** - Schematic figure for a solid with 1 degree of freedom-DOF-first case of loading

The move is as seen in (1), meaning that point/node A is $u_1=1$ and for point B is $u_2=0$. As for the forces see (1) and (2).

$$F_1 = k_{11} = -k_{21} = \frac{ES}{L}$$

(1)

$$F_2 = k_{21} = -\frac{ES}{L}$$

(2)

The low of static expressed by Hooke sais that the forces has to be in an equilibrium as (3):

$$F_1 + F_2 = 0$$

(3)

Another rewriting of (1), (2) and (3) is expressed in (4) by a matrix.

$$\{F\} = \begin{bmatrix} F_1 \\ F_2 \end{bmatrix} = \begin{bmatrix} K_{11} & K_{12} \\ K_{21} & K_{22} \end{bmatrix} \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

(4)

As expressed above, in a similar manner it is considered a movement in point A as $u_1=0$ and in point B $u_2=1$ as seen in (fig. no. 2).
The forces in point A and in point B become:

\[ F_2 = K_{22} = K_{11} = \frac{ES}{L} \quad (5) \]

and:

\[ F_1 = K_{21} = K_{12} = -\frac{ES}{L} \quad (6) \]

As a conclusion a final stiffness matrix for a solid with 1 degree of freedom is created and expressed in (7). Please note that a similar result is obtain by using Indirect Method.

\[
[K_f] = \begin{bmatrix} K_{11} & K_{12} \\ K_{21} & K_{22} \end{bmatrix} = \frac{ES}{L} \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} \quad (7)
\]

As for a solid with 6 degrees of freedom as in (fig. no. 3) where the forces/efforts are \(N_x, S_y, S_z, M_z, M_y, M_x\), and along each force/effort there is a degree of freedom, means there is a possibility for the point/node to move as in (fig. no. 4) and expressed as three linear movements along axes X,Y and Z (linear movements are: \(u, v, w\)) and three rotational movements around axes X,Y and Z (angular movements are: \(\phi_x, \phi_y, \phi_z\)), as expressed by Hutchinson [6].
Similar with procedure applied for solid with one degree of freedom, as expressed by Chiorean [3], a matrix 12x12 as in (10) would be the stiffness matrix and the movement vector $U_i$, and force vector $F_i$ as in (8) would create the final mathematical formulation as in (9).

$$
\{U_i\} = \begin{bmatrix}
    u_1 \\
    v_1 \\
    w_1 \\
    \varphi_{x1} \\
    \varphi_{y1} \\
    \varphi_{z1} \\
    u_2 \\
    v_2 \\
    w_2 \\
    \varphi_{x2} \\
    \varphi_{y2} \\
    \varphi_{z2}
\end{bmatrix}
\quad
\{F_i\} = \begin{bmatrix}
    N_1 \\
    T_{y1} \\
    T_{z1} \\
    M_{x1} \\
    M_{y1} \\
    M_{z1} \\
    N_2 \\
    T_{y2} \\
    T_{z2} \\
    M_{x2} \\
    M_{y2} \\
    M_{z2}
\end{bmatrix}
$$

(8)

$$
\{F_i\} = \{K_i\}\{U_i\}
$$

(9)
And the final mathematical formulation for stiffness matrix for a solid with 6 degree of freedom is expressed in (10). The main notice, according to Nam-Il Kim [8], that is to be made is that a good sense of understanding math principles would underline the fact that efforts are interdependent with some exceptions. The exceptions, [1] are among shear forces $T_{y,z}$ and moments $M_{y,z}$. A very odd observation leading to practical issues is an example of a solid that is solicited by a rotational effort along the axis $X$ leads to conclusion that there are not created efforts of elongation along axes $X$, with other words effort along axes $X$. This note is at least strange. Many researchers ignored that connection due to the fact that in structural static analyze of a building structure that effect is under 15% and mainly due to the fact that efforts of rotation along axes $X$ is rare in construction industry. Nevertheless for piping the effort interconnection is stronger due to circular shape and empty core cross section.

If a system of axes considered as coincident with forces and movements as expressed in (fig. no. 3) and (fig. no. 4), than the stiffness matrix is as expressed in (10). Please note that in a nonlinear analyze that is to be made the system of axes is mobile as the solid moves. Therefore it is necessary to express the connection among two different systems of axes: the local system represented by the solid and the global system represented by initial position of the solid. If the angles among axes are $\alpha_i$, $\beta_i$, $\gamma_i$, with $i=1,2,3$ ca as in (fig. no. 5) a mathematical formulation can be made according to Herno [5].
The mathematical formulation is found in (11).

\[ \{K_i\} = \{K_i\} \{T_i\} \]

(11)

With:

\[ \{T_i\} = \begin{bmatrix} \{T_i\} & \{0\} & \{0\} & \{0\} \\ \{0\} & \{T_i\} & \{0\} & \{0\} \\ \{0\} & \{0\} & \{T_i\} & \{0\} \\ \{0\} & \{0\} & \{0\} & \{T_i\} \end{bmatrix} \]

(12)

and

\[ \{T_i\} = \begin{bmatrix} a_i & b_i & c_i \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{bmatrix} \]

(13)

With notations:

\[ a_i = \cos \alpha_i, \quad b_i = \cos \beta_i, \quad c_i = \cos \gamma_i \]

(15)

With i=1,2,3 and:

\[ \alpha_1 - \text{angle} \ (x, x'), \quad \beta_1 - \text{angle} \ (y, y'), \quad \gamma_1 - \text{angle} \ (z, z') \]

\[ \alpha_2 - \text{angle} \ (x, y'), \quad \beta_2 - \text{angle} \ (y, z'), \quad \gamma_2 - \text{angle} \ (z, y') \]

\[ \alpha_3 - \text{angle} \ (x, z'), \quad \beta_3 - \text{angle} \ (y, z'), \quad \gamma_3 - \text{angle} \ (z, z') \]

(16)

The global stiffness matrix is composed by combining stiffness matrix for every component of the solid with respect to the common point/nodes and common effort/deformations. For the connections among deformations and efforts, it is easy to underline that connection in the (fig. no. 6) for a solid element with 3 degrees of freedom.

Figure 5 - Schematic figure for a solid with a different system of axis than the coincident system.
Figure.6- Degrees of freedom on a element stiffness matrix

\[
\{K_i\} = \begin{bmatrix}
    k_{11}^i & k_{12}^i & k_{13}^i & k_{14}^i & k_{15}^i & k_{16}^i \\
    k_{21}^i & k_{22}^i & k_{23}^i & k_{24}^i & k_{25}^i & k_{26}^i \\
    k_{31}^i & k_{32}^i & k_{33}^i & k_{34}^i & k_{35}^i & k_{36}^i \\
    k_{41}^i & k_{42}^i & k_{43}^i & k_{44}^i & k_{45}^i & k_{46}^i \\
    k_{51}^i & k_{52}^i & k_{53}^i & k_{54}^i & k_{55}^i & k_{56}^i \\
    k_{61}^i & k_{62}^i & k_{63}^i & k_{64}^i & k_{65}^i & k_{66}^i
\end{bmatrix}
\]

Please note that a gloabal stiffness matrix from each component stiffness matrix is done according to (fig. no. 7).

Figure.7- Schematic figure to compose global stiffness matrix along with a divided solid into elements

The final remark is that phenomena that take place at the level of the constituent element as seen in (fig. no. 7) is repeating at the level of global solid. With other words the connection among efforts is still missing sometimes. Therefore the valuable remark that interconnection among rotational effort and other efforts is of crucial importance in piping and sewage system especially when it comes to used systems.
Please note that piping and sewage system has a special demand in making connections by using torsional forces and movements as a screw is doing. The study above shows that such a demand is not clearly fundamental understood and therefore cannot be implemented with a real success. However there is a small amount of knowledge conducted by some pioneers that tries to make a connection among efforts as in (fig. no. 8) showing that effort outside the surrounding is eligible to fail, according to Liu [7].

![Figure 7: Graphic estimation of the interconnection among strain/stress relationship](image)

**3. CONCLUSIONS**

When it comes to new piping and sewage system the sustainability is insured by nothing else but laboratory tests and limited knowledge obtained by simple observation. Nevertheless there is no calculus or theoretical knowledge on how the piping system behaves in time on points like U turns, or where the material is partially melted due to installation process.

The most sensitive part of a sewage/piping system is where the connections are. The knowledge does not take into account long period of time testing of the connections tested in laboratory, according to Pfrang [9]. This would lead to significant delay of a certain material or process to be certified before being allowed on the market in our country or elsewhere. Therefore an effort of researchers is needed in order to create valuable knowledge about this calculus for piping and sewage system. This knowledge would lead to know when is appropriate or not to exchange the piping sewage system and so huge financial opportunities and demand is created. Nevertheless the education system is benefiting out of this proposed research as well as general well fair as well. More over a legislative proposal can be created as well. However linear analyses can be enough with the condition of making a connection among efforts, especially rotational and axial.

**References**


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MATHEMATICS - A CHALLENGE FOR ENGINEERING STUDENTS

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Abstract: The goal of this article is to go over certain problems concerning teaching of mathematics to engineering students, based on finds paradoxical situation in both Europe and the North America, that although there is a spectacular expansion of mathematics in all fields of knowledge, including engineering, mathematical education at all levels degrades. In these circumstances, the question is whether widespread use of computer technology might improve the mathematical training of students. We give some examples that highlight both the advantages and disadvantages of using specialized software packages.

Key words: mathematics teaching; engineering education; mathematics technology.

1. INTRODUCTION

There is a paradox developing between the spectacular expansion of mathematics in all fields of knowledge, including engineering, and the degradation of mathematical education at all levels. According to [6]:

"There is substantial evidence that, in developed countries, the interest in mathematics during the pre 18 year old school career has declined sharply in the last 20 years. In these countries, the level of performance in mathematics of students leaving high school is also subject to a (sometimes harsh) debate. Over the last two decades, this situation has already lead to statements about ways to alleviate these tendencies and initiatives to reform mathematics education"

In 1989 the US attempt to reform K-12 mathematical education by introducing standards and promoting with predilection the constructionism as teaching method resulted worsening. Disputes switched on curriculum, strategies, methods that had taken gave rise to the so-called “Math Wars” [6] [5]:

“There is a major controversy in K-12 math education. New curricula are coming into vogue that in large part replace the systematic teaching of algorithms with discovery learning, in which students are asked to find their own methods of solving problems. The new methods also de-emphasize memorization of multiplication tables in favor or reliance on calculators.

These new curricula are bad for several reasons: First, the instructional methods used are very time consuming, and much less material can be covered. Also, if you develop your own algorithms, they may well not be as powerful and efficient as the standard ones. As a result, students come away with less
mastery of the material they study, and it takes them longer to solve new problems whose solution would be immediate if they had learned comprehensive, efficient algorithms. “

Later mathematicians from Canada and Great Britain have taken a stand against educational policies that promoted the same kind of (reformed) curriculum. There is currently no consensus on strategies that could be applied. In the meantime, financial crisis around Europe, has resulted in some countries (including Romania) in salary cuts in the public sector and a number of educational changes, such as reduction of funding, merging of schools and universities, increase of the number of students in the classroom [8]. In this context, engineering institution face many problems. For example, in Romania:

- The mathematical background of students coming from high school are very different, and in recent years have become increasingly reduced (due to factors primarily related to educational policies: reducing the number of hours allocated for mathematical education at secondary and high level school, curricula and textbooks, frequent "changes").

- At the same time the number of hours allocated to the disciplines of mathematics curricula in the fields of engineering becomes smaller, but the knowledge that students must acquire and mathematical apparatus that they must (or should) learn to use have become increasingly advanced.

- Moreover we should mention the difficulty of teaching large classes with inadequate facilities and in some cases the increase teaching load (due to the reduction of funding).

In these circumstances, the question is whether widespread use of computer technology might improve the mathematical training of students. First of all let us mention that there are two distinct ways in which user-friendly of mathematical software affects learning and teaching in mathematics. According to [7], the first is that new technology provides opportunities for new approaches to teaching and learning, and the second is that advances in technology impact not only on how mathematics is taught but also on what mathematics is taught.

In the next section we give some examples that highlight both the advantages and disadvantages of using specialized software packages.

### 2. MATHEMATICS TECHNOLOGY. MAPLE

In [7] the following risks have been identified when using (extensively and exclusively) mathematics technology:

- Loss of basic capabilities
- Loss of connection between procedures and understanding
- Pure trial and error working style without thinking
- Tool dependence and “faith”

In this section we will illustrate the fact that the phrase "the result is provided by the computer, so it is right" it is not always true. In the following we exemplify, using Maple, a small part of the basic problems that can arise in numerical calculations (such kind of examples are usually included in many Numerical Methods lecture notes, see for instance [1]). Our motivation of using Maple in teaching Numerical Methods [3] and Optimization Methods [5] comes from its combination of symbolic and numerical computing capabilities, as well as from its visualization abilities of functions and geometric 2D/3D-objects.

Most computers represent both integer and floating point numbers internally using the binary number system (IEEE 754 standard). However, to some extent it is non-intuitive for humans, especially for fractional numbers. Let us consider the binary representation of 1/10:

1/10 = 0.0001100110011...=1, 10011001100110011001101...2^-4.

Thus 1/10 cannot be represented exactly in any finite binary system, because the sequence of digits must either be truncated (chopped) or rounded to a finite number of binary digits. The error produced is called the round-off error due to inexact representation. Round-off error is also produced by (in principle) every IEEE 754 operation
(addition, subtraction, multiplication, division). IEEE 754 defines two binary floating point representations: single precision, using 32 bits for each number (the number mantissa bits is 24, i.e. approximately 7 decimal digits) and double precision, using 64 bits for each number (the number mantissa bits is 53, i.e. approximately 15 decimal digits). Maple represents floating point numbers in decimal using a user-specified precision controlled by the global variable \( \text{Digits} \). In order to evaluate an expression to a numerical value using the floating-point hardware of the underlying system we can use Maple \text{evalhf} \) function. The evaluation is done in double precision.

The following example illustrates that the small round-off error due to inexact representation of \( \frac{1}{10} \) in a finite binary system, when multiplied by the large number lead to a significant error:

\[ \text{Digits} := 15; \text{Digits} := 15; \]
\[ \text{evalf}(1/10); z := 10^{20}; \]
\[ f := 0.100000000000000; \]
\[ z := 100000000000000000000; \]
\[ \text{for} \ i \ \text{from} \ 20 \ \text{to} \ 23 \ \text{do} \ z := z*10; \text{printf(\"\n%f*10^%d-10^%d = %f\",f,i+2,i+1,evalhf(f*(z*10)-z)) end do;\]
\[ 0.100000*10^{22}-10^{21} = 0.000000 \]
\[ 0.100000*10^{23}-10^{22} = 0.000000 \]
\[ 0.100000*10^{24}-10^{23} = 0.000000 \]
\[ 0.100000*10^{25}-10^{24} = 134217728.000000 \]

We do not accidentally consider 0. The fact 0.1 is not exactly representable in a binary finite system was the cause of an American Patriot Missile battery error on February 25, 1991 (which failed to intercept an incoming Iraqi Scud missile; the Scud struck an American Army barracks and killed 28 soldiers [2]).

The preceding computations in a decimal system are right:

\[ \text{Digits} := 15; \text{Digits} := 15; \]
\[ \text{evalf}(1/10); z := 10^{20}; \]
\[ f := 0.100000000000000; \]
\[ z := 100000000000000000000; \]
\[ \text{for} \ i \ \text{from} \ 20 \ \text{to} \ 23 \ \text{do} \ z := z*10; \text{printf(\"\n%f*10^%d-10^%d = %f\",f,i+2,i+1,evalf(f*(z*10)-z)) end do;\]
\[ 0.100000*10^{22}-10^{21} = 0.000000 \]
\[ 0.100000*10^{23}-10^{22} = 0.000000 \]
\[ 0.100000*10^{24}-10^{23} = 0.000000 \]
\[ 0.100000*10^{25}-10^{24} = 0.000000 \]

(The Maple \text{evalf} \ command numerically evaluates expressions - floating point arithmetic using a decimal system with the precision \( \text{Digits} \)). Though these computations are all right, this not means that the floating point arithmetic implemented in Maple is exact. For any fixed precision and any base the same problems arise as with binary IEEE 32- and 64-bit arithmetic, but for different data and at a different point:

\[ \text{Digits} := 15; \text{Digits} := 15; \]
\[ \text{evalf}(1/3); z := 3^{31}; \]
\[ f := 0.333333333333333; \]
\[ z := 61767396283947; \]
\[ \text{for} \ i \ \text{from} \ 31 \ \text{to} \ 34 \ \text{do} \ z := z*3; \text{printf(\"\n%f*3^%d-3^%d = %f\",f,i+2,i+1,evalf(f*(z*3)-z)); end do;\]
\[ 0.333333*3^{33}-3^{32} = 0.000000 \]
0.333333*3^34-3^33 = 0.000000
0.333333*3^35-3^34 = 0.000000
0.333333*3^36-3^35 = -200.000000

If we increase precision the problem disappears:

```maple
> Digits:=16; f:=evalf(1/3); z:=3^31;

Digits := 16
f := 0.3333333333333333
z := 61767396283947

> for i from 31 to 34 do z:=z*3: printf("\n%f*3^%d-3^%d= %f",f,i+2,i+1,evalf(f*(z*3)-z));
end do:
0.333333*3^33-3^32 = 0.000000
0.333333*3^34-3^33 = 0.000000
0.333333*3^35-3^34 = 0.000000
0.333333*3^36-3^35 = 0.000000
```

But if we increase the power of 3 the problem reappears:

```maple
> Digits:=16; f:=evalf(1/3); z:=3^33;

Digits := 16
f := 0.3333333333333333
z := 5559060566555523

> for i from 33 to 36 do z:=z*3: printf("\n%f*3^%d-3^%d= %f",f,i+2,i+1,evalf(f*(z*3)-z));
end do:
0.333333*3^35-3^34 = 0.000000
0.333333*3^36-3^35 = 0.000000
0.333333*3^37-3^36 = 0.000000
0.333333*3^38-3^37 = -100.000000
```

Of course in Maple we can use symbolic computation and thus obtain an exact result:

```maple
> f:=1/3; z:=3^33;

f := 1/3
z := 5559060566555523

> for i from 33 to 36 do z:=z*3: printf(%f,%f,%f,%f)
end do:
16677181699666569, 16677181699666569, 0,
50031545098999707, 50031545098999707, 0,
150094635296999121, 150094635296999121, 0,
4502839058909997363, 4502839058909997363, 0
```

Another problem is the so-called gradual loss of significance. Let us consider the following examples:

```maple
> f:=evalhf(4/3): for i from 1 to 15 do f:=evalhf((f-1)*4); end do:
> f:=evalhf((f-1)*4); printf("\n%f",f) end do:
1.333333
1.333332
1.333328
1.333313
1.333252

> f:=evalhf(4/3): for i from 1 to 25 do f:=evalhf((f-1)*4); end do:
> f:=evalhf((f-1)*4); printf("\n%f",f) end do:
1.000000
0.000000
We have already illustrated an unavoidable error that results from approximating a real number (in our case a rational one) that is not representable within a floating-point number system, as well as the fact that this error can grow astronomically.

Another typical error occurs when subtracting two numbers $x-y$ nearly equal in magnitude. Most of the leading digits are equal, so they disappear after the subtraction. The differences of the last digits are promoted to the most significant digit positions. But the last digits can be totally wrong (for instance, if the numbers are themselves subject to round-off errors) and the same is the result of subtraction (we have a catastrophic cancellation). Also devastating loss of precision occurs when small numbers are computed from large numbers.

In the following Maple procedure we approximate $\cos(x)$ by a partial sum of the series

$$\sum_{n=0}^{\infty} \frac{(-1)^n x^{2n}}{(2n)!},$$

using Mac Laurin Formula. The series is alternating and $\left(\frac{|x|^{2n}}{(2n)!}\right)_n$ decreases to zero. Thus a partial sum of order $n$, $s_n=\sum_{k=0}^{n} \frac{(-1)^k x^{2k}}{(2k)!}$, approximates $\cos(x)$ (the sum of the series) and the absolute value of the absolute error (the truncation error) is less than or equal to the absolute value of the first term omitted: $\frac{|x|^{2n+2}}{(2n+2)!}$.

```maple
cosV1:=proc(x,epsilon)
local t, x2, i,s;
s:=0; i:=1; t:=1; x2:=x*x;
while evalf(abs(t)-epsilon)>=0 do
s:=s+t; t:=-t*x2/(4*i*i-2*i);i:=i+1
end do;
RETURN(s)
end proc;
```

Let us also consider the function $\cosD$ obtained from the preceding procedure letting $\epsilon=10^{-\text{Digits}}$:

```maple
cosD:=x->cosV1(x,10^(-\text{Digits}));
```

Let us compare the results of our function with the $\cos$ implemented in Maple ($\text{Digits}=15$):

```maple
evalf(cosD(3));
-0.989992496600446
evalf(cos(3));
-0.989992496600445
cosD(3.);
-0.989992496600445
cos(3.);
-0.989992496600445
evalf(cosD(40));
-0.666938061652262
```
Let us note the approximation of \( \cos(40.) \) with 41.256... The error is due in this case to loss of precision that occurs when small numbers are added to/subtracted from large numbers. We remark that when the computation is symbolic (the call of \( \cosD(40) \)), then the result is accurate. We can graphically illustrate these facts:

\[
> \text{Digits:=10; plot([cosD,cos],-42..42);} \\
> \text{n:=400;}
\]

\[
> d1:=\text{plots:-pointplot([seq([-42+84/n*i,\cosD(-42+84/n*i)],i=0..n)],color=red)}: \\
> d2:=\text{plot(cos,-42..42,color=green)}: \\
> \text{plots:-display(d1,d2);} \\
\]
We can improve the procedure using the periodicity of the function \( \cos \):

\[
\cosV2 := \text{proc}(x, \epsilon) \\
\text{local } t, x2, i, s; \\
s := 0; i := 1; t := 1; x2 := \text{evalf}((x - \text{floor}(x/(2*\pi))*2*\pi)*(x - \text{floor}(x/(2*\pi))*2*\pi)); \\
\text{while } \text{evalf(abs}(t) - \epsilon) >= 0 \text{ do} \\
s := s + t; t := -\text{evalf}(t*x2/(4*i*i - 2*i)); i := i + 1 \\
\text{od}; \\
\text{return}(s) \\
\end{\text{proc}}
\]

\[
\text{Digits} := 15: \cosV2(400., 10^(-Digits)); \\
\text{-0.525296338642618} \\
\]

Another variant is to use the Maple command \text{sum} to add the terms inside the procedure:

\[
\cosV3 := \text{proc}(x, \epsilon) \\
\text{local } t, x2, i, n, s; \\
n := 1; t := 1; x2 := x^2; \\
\text{while } \text{evalf}(\text{abs}(t) - \epsilon) >= 0 \text{ do} \\
s := s + t; t := -t*x2/(4*n*n - 2*n); n := n + 1 \\
\text{od}; \\
s := \text{sum}(x2^i*(-1)^i/((2*i)!), i = 0..n); \\
\text{return}(s) \\
\end{\text{proc}}
\]

\[
\text{evalf(cos(Pi/6 + 2*Pi*20));} \\
0.866025403784440 \\
\]

\[
\text{evalf(cosV2(Pi/6 + 2*Pi*20, 10^(-Digits)));} \\
0.866025403784439 \\
\]

We end this section with an example showing that the visualization tools in Maple are useful for demonstration of results, as well as solving mathematical problems. Let us suppose that we are trying to solve the equation \( \cos(\pi x) + \ln(x) + 1 = 0 \) using Maple command \text{fsolve}.

\[
\text{fsolve(cos(Pi*x)+ln(x)+1,x);} \\
1. \\
\]

If we draw the function \( x -> \cos(\pi x) + \ln(x) + 1 \), we see that the equation has more solutions.

\[
\text{plot(cos(Pi*x)+ln(x)+1,x=0.01..8);} \\
\]
3. CONCLUSIONS

Using Maple in teaching Numerical Methods has the following advantages:
- It is an excellent instrument to explain the fundamental differences between numerical and symbolic computation. In general it can be used to illustrating mathematical concepts.
- It helps students to recognize sources of errors in numerical computations.
- It gives the possibility to combine numerical and symbolic routines to solve problems in engineering practice.
- Graphical facilities of Maple are useful for demonstration/visualization of results.

On the other hand
- Using Maple requires learning its syntax. So there is a cost of using Maple.
- Also in Maple approximations can be computed to any precision that is required (by setting the global variable Digits), the symbolic computations and the theoretically "infinite precision" may need (extremely) long time for a response.
- Engineering students should understand that mathematics provides useful tools and language for expressing various real world phenomena. They should learn about the limitations of specialized software programs, and they should be able to check the plausibility of program output in order to use it safely.

Bibliography
[6]* The Future of Mathematics Education in Europe” Lisbon, Portugal, December 17-18, 2007 - A Conference under the auspices of the Academia Europaea in the framework of the Portuguese EU Presidency, European Review, Volume 17, Issue 01, 2009, 213-
215.
CONCERNING TO SUSTAINABLE DEVELOPMENT CONCEPT

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Abstract: Sustainable development is maintaining a delicate balance between the human need to improve lifestyles and feeling of well-being on one hand, and preserving natural resources and ecosystems, on which we and future generations depend. The essence of this form of development is a stable relationship between human activities and the natural world, which does not diminish the prospects for future generations to enjoy a quality of life at least as good as our own. For all of this to keep on the control the people all around the world use it statistical date like worldmeters which counters on display the real-time numbers like in example from my paper about: world population, government and economics, society and media, environment, food, water, energy, health.

Key words: sustainable development, concept, worldmeters, statistical data

1. INTRODUCTION

The concept of sustainable development (sustainable) crystallized in time, during several decades, through scientific debates internationally and acquired precise political meanings in the context of globalization. In recent history, the first alert that economic and social developments of the countries of the world and of humanity as a whole can’t be separated from the consequences of human activity on the natural environment was made in the 1972 report of the Club of Rome entitled Limits to Growth (Meadows Report).

The document summarized the data on the evolution of five factors (population growth, the impact of industrialization, pollution, food production and natural resource depletion trends), suggesting the conclusion that the development model in that period can’t be sustained long term. The problematic relationship between humankind and the environment became the international community’s concerns since the United Nations Conference on Environment (Stockholm, 1972) and resulted in the work of the World Commission on Environment and Development, established in 1985. The report of the Commission presented in 1987 G.H.Bruntland our Common Future offered the first broadly accepted definition of sustainable development as "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs".
The concept of sustainable development proposes an integrated approach to policy and decision in which environmental protection and long-term economic growth are seen as complementary and interdependent.

From this point, the complex problems of sustainable development acquired a global political dimension being addressed at the highest level at the World Conference on Environment and Sustainable Development in Rio de Janeiro (1992), the Special Session of the General Assembly and adoption Millennium Development Goals (2000) and the World Conference on Sustainable Development in Johannesburg (2002). They have outlined thus concrete programs of action at global and local (Local Agenda 21) according to the principle "think globally, act locally".

It is recognized, therefore, that the Earth has a limited capacity to meet the growing demand for natural resources from the socio-economic and absorb the destructive effects of their use. Climate change, soil erosion and desertification, soil, water, air, surface reducing forest systems, and tropical wetlands, the extinction or endangerment of a large number of species of terrestrial or aquatic plants and animals, accelerated depletion of non-renewable natural resources. They began to bite, measurable, on socio-economic development and the quality of life in vast areas of the planet.

2. THE CRITERIAL DECISION ANALYSIS.
WORLDMETERS EXAMPLE

Statistical Procedures provides a set of tools that enable researchers to their empirical findings sumeze in a way that can be easily introduced to the audience targeted and can be understood without difficulty. Multivariate analysis comprises a set of techniques dedicated to examining the relationship between more than two variables, which are random, but interdependent, so that their different effects can't be significantly interpreted separately (Roman, 2012).

Worldometers is an independent global project presentation in real time statistics for multiple parameters. It is available to anyone, anywhere on the globe, in over 30 languages. Work on the project is voluntary and sources for statistics are among the most respected organizations. That the United Nations Statistics Division to the National Statistical Offices from a variety of
countries around the globe, as well as independent research company Worldometers is quoted in over 800 books published in more than 500 professional journal articles and over 150 pages in Wikipedia.

The site is considered a formidable educational tool and is shown in classrooms around the world.

2.1.1. HOW IT WORKS WORLDMETERS.

The counters which displays real-time numbers are based on processing algorithm Worldometers newest and most accurate available statistics, calculates an estimated progression milliseconds to be displayed on each meter on the time each specific set your computer clock visitor.

I'll present in the following examples metering images in real time: the world's population, government and economy, society and media, environment, water, energy, health.

The project presents the most important data of humanity, from birth to government spending, health status or environmental condition and consumption or energy production globally.

![WORLD POPULATION](image1)

**WORLD POPULATION**

7,316,562,415  Current World Population

Public Healthcare expenditure today

53,853,402  Births this year

expenditure today

163,162  Births today

expenditure today

22,220,560  Deaths this year

67,323  Deaths today

year

31,632,842 Net population growth this year

Computers produced this year

(fig no.2.) World populations

![GOVERNMENT & ECONOMICS](image2)

**GOVERNMENT & ECONOMICS**

$4,626,092,579

Public Healthcare expenditure today

$ 4,077,437,878 Public Education

$ 2,057,839,377 Public Military

26,239,562 Cars produced this year

54,092,832 Bicycles produced this year

23,162,842 Net population growth this year

(fig no.3.) Government and economics

![SOCIETY & MEDIA](image3)

**SOCIETY & MEDIA**

974,637  New book titles published this year (hectares)

2,014,437 Forest loss this year

214,572,713 Newspapers circulated today

2,711,977 Land lost to soil erosion this year (ha)

283,064 TV sets sold worldwide today

13,941,096,711 CO2 emissions this year (tons)

2,271,172 Cellular phones sold today

4,648,232 Desertification this year (hectares)
$ 82.962.162  Money spent on videogames today  3.793.104  Toxic chemicals released in the
3.128.610.229  Internet users in the world  environment this year
92.676.741.564  Emails sent today
1.675.576  Blog posts written today
343.676.991  Tweets sent today
1.819.614.669  Google searches today

(fig. no.4.) Society and media
(fig. no.5.)

Environment

WOOD

799.246.540  Undernourished people in the world
year (billion L)
1.608.560.814  Overweight people in the world
536.186.938  Obese people in the world
13.232  People who died of hunger today

1.920.384  Water consumed this year
1.608.560.814  Water consumed this year
697.544  Deaths caused by water related diseases this year
697.419.898  People with no access to water

$ 207.759.102  Money spent for obesity related diseases in the USA today
$ 81.793.270  Money spent on weight loss programs in the USA today

(fig. no.6.) Food
(fig. no.7.) Water

ENERGY

170.114.356  Energy used today (MWh), of which:
137.791.897  from non-renewable sources (MWh)
32.322.477  - from renewable sources (MWh)

5.028.230  Communicable disease deaths
2.944.129  Deaths of children under 5 year
16.272.114  Abortions this year

Solar energy striking Earth today

39
<table>
<thead>
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<th>Description</th>
<th>Value</th>
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<tbody>
<tr>
<td>Oil pumped today (barrels)</td>
<td>36.404.922</td>
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<tr>
<td>Oil left (barrels)</td>
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<tr>
<td>Days to the end of oil (~39 years)</td>
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<tr>
<td>Deaths of mothers during this year</td>
<td>137.158</td>
</tr>
<tr>
<td>Deaths of mothers during this year</td>
<td>1.182.353.066.748</td>
</tr>
<tr>
<td>HIV/AIDS infected people</td>
<td>37.198.546</td>
</tr>
<tr>
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<td>59.501</td>
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<td>Gas left (boe)</td>
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<tr>
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<td>651.129</td>
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<tr>
<td>Days to the end of gas this year</td>
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<td>HIV/AIDS infected people this year</td>
<td>3.181.125</td>
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<tr>
<td>Days to the end of coal this year</td>
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<td>36.404.922</td>
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From the press today, if you were to have access to all, you had a choice between 214,572,713 pages of newspapers. You were, because data is changing with incredible speed. For bibliophiles, another good news, because books can complete their collection with 974,637 new titles this year. And fans of new media and been enriched by reading blogs options 1,675,576 articles.

- the environment for those sympathetic to the cause of ecological (fig.no.5.)

You want to know how many tons of carbon dioxide in the atmosphere have been issued this year? Look at the numbers on Worldometers. Take on a chair and sit down. The figure is staggering 13,941,096,711. Or
maybe it's interested in how many hectares of forest grubbed up 4,648,232 as land turned into desert or how many species have disappeared by now.

- **alimentation (fig.no.6.)**
  It can easily see how many people are currently the undernourished 799,246,540 or how many people die of hunger 13,232apa

- **water (fig.no.7.)**
  As you can observed the number of people without access to drinking water is concerned 697,419,898 people

- **energy(fig.no.8.)**
  If you are thought to do a business plan in the field of oil, you should note that these resources will be feasible finish in 42 years. Apparently, it's a business their grandchildren let. Instead, you can see in real time what kind of energy used today and which is the potential energy of sunlight for the day.

- **Health (fig.no.9.)**
  Related to health the number of deaths seems worryingly children under 5 years 2,944,129 children this year or the number of cigarettes smoked 6,582,120,236 These data are not 100% accurate (not possible), but helps us get an idea about the difference between the number of deaths and the number of births, the amount of oil that also has the planet, the number of hectares of forest lost this year deaths caused by various factors, the number of searches performed on Google, electricity consumed in a day, its sources and many other interesting data.

### 3. CONCLUSIONS

Sustainable development brings to the fore a new set of values that will guide future model of economic progress and social values aimed especially man and his needs of present and future natural environment - protection and conservation, and mitigation of actual damage ecosystems.

Regarding the statistics presented by wordmeters can do the following things:

- To create an appropriate institutional and legislative framework and effectively through greater use of forward-looking strategies and greater knowledge (today amazingly poor, in the final analysis) about relationships and correlations between economy and environment
  - To have a long term vision on development;
  - To have systemic thinking - the interconnection between environment, economy and society;
  - Improved resource management in order to reduce their use and increasing product competitiveness in the market;
  - Improving energy efficiency and promoting renewable energies;

### Bibliografie

STUDY ON A METHOD FOR DETERMINING AS ACCURATELY AS POSSIBLE THE “DEVELOPMENT” OF AN ELLIPSOID

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Abstract: In this paper it is proposed both a graphical method and a computerized method for obtaining the “development” of elongated ellipsoid of revolution. The proposed computerized method can be used when it is desired to obtain a more accurate “development” and a rigorous control of the errors with which the “development” is achieved. The drawing of the “development” by means of the computer-assisted method offers the possibility of obtaining greater accuracy because we can choose a convenient number of fuses, number of level planes, as well as spline functions of various degrees.

Key words: ellipsoid, “development”, graphical method, computerized method

1. INTRODUCTION

Some parts of machines and installations are obtained by sheet iron folding, after having previously drawn the “development” of the piece on the sheet surface.

Drawing the deployable surface on material requires a good knowledge of principles and methods for transposing the surfaces of three-dimensional space in two-dimensional space. In technique there are met both deployable surfaces and non-deployable surfaces. For non-deployable surfaces there were established methods by means of which there are obtained surfaces by folding close to the geometric shape and dimensions required.

Descriptive geometry shows approximate methods for the deployment of surfaces of revolution. Specialized books offer in full graphical methods for sphere and only a few general references to the other non-deployable surfaces of revolution.

In [6] there are shown the approximate graphical methods for determining the “development” of toroidal surfaces and of a cylindroid surface. In [7] there are shown the computerized methods for drawing the sections in geometric solids, intersections of geometric solids and evolutes of ruled surfaces. In [2,3] there are shown studies on the drawing of the sphere “development” by means of new approximate graphical and computerized methods.

In this paper it is proposed both a graphical method and a computerized method for obtaining the “development” of elongated ellipsoid of revolution. The paper also presents the calculation of errors of the evolute determined by means of the computerized method. The technique applications require great accuracy in the realization of parts. The accuracy increasing can be done by means of computer-assisted graphic-analytical methods.
2. THE “DEVELOPMENT” OF AN ELLIPSOID OBTAINED BY MEANS OF THE GRAPHICAL METHOD

The ellipsoid of revolution is the surface resulting by the ellipse revolution around one of its axes. In this paper there is shown the “development” of an elongated ellipsoid obtained by means of the ellipse revolution around the major axis. The “development” of the ellipsoid can be achieved by dividing the surface in several fuses.

For the ellipsoid in Figure 1.a there is shown the “development” graphically determined by adapting the method of spherical fuses specific to the “development” of the sphere [5]. When drawing the “development” we used a number of arbitrarily chosen auxiliary planes (level planes and vertical planes), so that construction is as clear as possible. In figure 1.a there are drawn the level planes [Ni] at distances determined by dividing the angle $90^\circ$ into four equal parts. The level plans section the surface according to parallel circles. In Figure 1.b there is shown the approximate “development” of a fuse, obtained with six vertical planes $P_1, \ldots, P_6$. Thus the “development” of the ellipsoid will be made up of 12 fuses (Fig. 2). The accuracy of determining the “development” increases with the number of level planes and vertical planes.

Fig.1.a,b. The “development” of an ellipsoid fuse obtained by means of the graphical method
3. THE “DEVELOPMENT” OF AN ELLIPSOID OBTAINED BY MEANS OF COMPUTER-ASSISTED METHOD

We consider an ellipsoid of revolution having the following implicit representation:

\[ \frac{x^2}{b^2} + \frac{y^2}{b^2} + \frac{z^2}{a^2} = 1 \]

In the next example \( a=2, \) \( b=1 \) and the previous ellipsoid is parametric represented:

\[ \text{plot3d}([\cos(u)\cos(v),\sin(u)\cos(v),2*\sin(v)], u=0..\pi, v=0..2*\pi, \text{scaling=constrained}); \]

In the following \( n \) = the number of projector planes (vertical, containing one meridian) and \( m \) = the number of level planes (horizontal) above the equator. In consequence there will result 2n fuses and the level planes (parallels) will determine 2m segments on each fuse, which together with the equator will divide each fuse in 2m + 2 parts. The segments determined on fuses are equal to the lengths of some arcs of circles (Fig. 3).
We will approximate the length of the subtended arc with an angle $\alpha$ at the center of a circle of $r$ radius with $2r \sin \frac{\alpha}{2}$ (the approximation of the arc with the corresponding chord, fig. 4)

We consider the following parametric representation of a generic ellipse resulted by sectioning the ellipsoid with a vertical plane:

\[
\begin{align*}
xt &= (a, b, t) \mapsto \frac{a \cdot b}{(a^2 \cos(t)^2 + b^2 \sin(t)^2)^{1/2}} \cdot \cos(t) \\
yt &= (a, b, t) \mapsto \frac{a \cdot b}{(a^2 \cos(t)^2 + b^2 \sin(t)^2)^{1/2}} \cdot \sin(t)
\end{align*}
\]

The arc lengths ($d\sigma$) is:

\[
\begin{align*}
arct &:=(a,b,t)\mapsto (\text{diff}(xt(a,b,t),t)^2 + \text{diff}(yt(a,b,t),t)^2)^{1/2};
\end{align*}
\]

Maple procedure puncte_fus_coarda calculates the lengths/2 of segments determined on each fuse by level planes taking into account the approximation of the arc with the corresponding chord.

We give as an example of the use of this procedure for the case $n = 6$, $m = 3$, both symbolically (for a spheroid characterized by $a$ (vertical semi-axis) and $b$ (horizontal semi-axis) and numerically (for an ellipsoid of revolution (spheroid) with $a = 2$ and $b = 1$):
\[
\begin{bmatrix}
0, & \frac{a \ b \ \cos \left( \frac{3 \ \pi}{8} \right) \ \sin \left( \frac{\pi}{12} \right)}{\sqrt{a^2 \ \cos \left( \frac{3 \ \pi}{8} \right)^2 + b^2 \ \sin \left( \frac{3 \ \pi}{8} \right)^2}}, & \frac{a \ b \ \sqrt{2} \ \sin \left( \frac{\pi}{12} \right)}{\sqrt{\frac{a^2}{2} + \frac{b^2}{2}}}, & 0
\end{bmatrix}
\]

> map(evalf,puncte_fus_coarda(2,1,6,3));

\[
\begin{bmatrix}
0.0, & 0.1651141205, & 0.2314947914, & 0.2534406704, & 0.2588190451, & 0.2534406704, & 0.2314947914, & 0.1651141205, & 0.,
\end{bmatrix}
\]

Procedure \texttt{lungime_elipsa} calculates the lengths of an ellipse of semi-axes \(a\) and \(b\).

> lungime_elipsa:=proc(a,b) local l; l:=int(arct(a,b,t),t=0..2*Pi,numeric=true); RETURN(l) end proc;

The \texttt{puncte_fus} procedure calculates the points determined on the vertical on the axis of symmetry of a certain fuse by horizontal planes.

> puncte_fus:=proc(a,b,n,m) local i,puncte; puncte:=\{seq(0,i=0..2*m+2)\}; puncte[1]:=0; puncte[2*m+3]:=lungime_elipsa(a,b)/2; for i from 1 to m+1 do puncte[i+1]:=puncte[i]+int(arct(a,b,t),t=Pi/2-i*Pi/(2*(m+1))..Pi/2-(i-1)*Pi/(2*(m+1)),numeric=true); puncte[2*m+3-i]:=lungime_elipsa(a,b)/2-puncte[i+1] end do; RETURN(puncte) end proc;

We give as an example of the use of the procedure \texttt{puncte_fus} for the case \(n = 6, m = 3\), for a spheroid with \(a = 2\) and \(b = 1\):

> map(evalf,puncte_fus(2,1,6,3));

\[
\begin{bmatrix}
0., & 0.8219495090, & 1.519260312, & 2.015794404, & 2.422112054, & 2.828429706, & 3.324963798, & 4.022274601, & 4.844224110
\end{bmatrix}
\]

Maple procedure \texttt{aproximare_coarda_semi_fus1} calculates the value in a point of the function associated to the points determining a semi-fuse (approximation by spline functions of \(d\) degree).

> aproximare_coarda_semi_fus1:=proc(a,b,n,m,d,X) local puncte,valori,i; puncte:=puncte_fus(a,b,n,m); valori:=puncte_fus_coarda(a,b,n,m); RETURN(CurveFitting:-Spline([seq([puncte[i],valori[i]], i=1..2*m+3)], X,degree=d)) end proc;

We plot the preceding function for the particular case of \(a = 2, b = 1, n = 6, m = 3, d = 3\).

> plot(aproximare_coarda_semi_fus1(2,1,6,3,3,X), X=0..lungime_elipsa(2,1)/2,scaling=constrained);
Maple procedure \texttt{aproximare\_coarda\_semi\_fus} symmetrizes the functions associated to the points that determine a semi-fuse. \texttt{aproximare\_coarda\_semi\_fus:=proc(a,b,n,m,d,X)local f;
f:=unapply(aproximare\_coarda\_semi\_fus1(a,b,n,m,d,X),X);
RETURN((f(X)+f(lungime\_elipsa(a,b)/2-X))/2) end proc;}

We plot the function for the particular case of \(a=2,\ b=1,\ n=6,\ m=3,\ d=3\).
\[
> \text{plot(aproximare\_coarda\_semi\_fus(2,1,6,3,3,X),}
> \text{X=0..lungime\_elipsa(2,1)/2,scaling=constrained);}
\]

Maple procedure \texttt{arie\_fus\_coarda\_aproximare} computes the area of a fuse. 
\[
> \text{arie\_fus\_coarda\_aproximare:=proc(a,b,n,m,d)}
> \text{RETURN(2*int(aproximare\_coarda\_semi\_fus(a,b,n,m,d,X), X=0..lungime\_elipsa(a,b)/2))}
> \text{end proc;}
\]

We exemplify its utility in the particular case of \(a=2,\ b=1,\ n=6,\ m=3,\ d=3\).
\[
> \text{evalf(arie\_fus\_coarda\_aproximare(2,1,6,3,3));}
> 1.758899313
\]

Maple procedures \texttt{eroare\_fus\_coarda\_aproximare} calculate the error with which the deployable surface approximates the ellipsoid area.
\[
> \text{eroare\_fus\_coarda\_aproximare:=proc(a,b,n,m,d)}
> \text{local e, arie, arie\_aprox;}
> \text{arie\_aprox:=evalf(2*n*arie\_fus\_coarda\_aproximare(a,b,n,m,d));}
> \text{print(`Aria suprafetei desfasurate prin fuse (coarde) (Area of the surface development approximation)`}, arie\_aprox);
> \text{if (a>b) then e:=(a^2-b^2)^(1/2)/a; arie:=evalf(2*Pi*b^2+2*Pi*a*b/e*(sin@@(-1))(e)) end if;}
> \text{if (b>a) then e:=(b^2-a^2)^(1/2)/b; arie:=evalf(2*Pi*b^2+Pi*a^2/e*ln((1+e)/(1-e))) end if;}
> \text{if (a=b) then arie:=evalf(4*Pi*a^2) end if;}
> \text{print(`Aria elipsoidului de rotatie (Ellipsoid of revolution surface area)`},arie);
> \text{print(`Eroare absoluta (Absolute Error)`},evalf(ario-arie\_aprox));
> \text{print(`Eroare relativa (Relative Error) (%)`},evalf(abs(ario-arie\_aprox)/arie*100))}
> \text{end proc;}
\]
We give as an example of the use of these procedures for the case $n = 6$, $m = 3$, with $a = 2$, $b = 1$ and the degree of spline functions $d = 3$, then with $d = 1$ .

$> \text{eroare\_fus\_coarda\_aproximare(2,1,6,3,3);}$

Aria suprafeței desfăurate prin fuse (coarde) (Area of the surface development approximation), $21.10679176$

Aria elipsoidului de rotatie (Ellipsoid of revolution surface area), $21.47843534$

Eroare absoluta (Absolute Error), $0.37164358$

Eroare relativa (Relative Error) (%), $1.730310305$

$> \text{eroare\_fus\_coarda\_aproximare(2,1,6,3,1);}$

Aria suprafeței desfăurate prin fuse (coarde), $24.55730366$

Aria sferei, $21.47843534$

Eroare absoluta, $-3.07886832$

Eroare relativa (%), $14.33469557$

$> \text{eroare\_fus\_coarda\_aproximare(2,1,6,3,1);}$

Aria suprafeței desfăurate prin fuse (coarde) (Area of the surface development approximation), $20.66885528$

Aria elipsoidului de rotatie (Ellipsoid of revolution surface area), $21.47843534$

Eroare absoluta (Absolute Error), $0.80958006$

Eroare relativa (Relative Error) (%), $3.769269256$

The next procedure draw horizontally a semi-fuse as well the points that determine it.

$> \text{desen\_semi\_fus\_coarda:=proc(a,b,n,m,d) }$

$> \text{local d1,d2,d3,punctex,punctey; }$

$> \text{punctex:=puncte\_fus(a,b,n,m); }$

$> \text{punctey:=puncte\_fus\_coarda(a,b,n,m); }$

$> \text{d1:=plot(aproximare\_coarda\_semi\_fus(a,b,n,m,d,X),X=0..lungime\_elipsa(a,b)/2,axes=none); }$

$> \text{d2:=pointplot([[0,0],[lungime\_elipsa(a,b)/2,0]], connect=true); }$

$> \text{d3:=seq(pointplot([punctey[i],punctex[i]],symbol=CIRCLE, axes=none),i=1..2*m+3);display(d1,d2,d3, scaling=constrained); }$

$> \text{end proc; }$

$> \text{desen\_semi\_fus\_coarda(2,1,6,3,1), Fig.7.}$

The following procedure draw vertically a semi-fuse as well the points that determine it.

$> \text{desen\_semi\_fus\_coarda\_vertical:=proc(a,b,n,m,d) }$

$> \text{local d1,d2,d3,punctex,punctey; }$

$> \text{punctex:=puncte\_fus(a,b,n,m); }$

$> \text{punctey:=puncte\_fus\_coarda(a,b,n,m); }$

$> \text{d1:=plot([aproximare\_coarda\_semi\_fus(a,b,n,m,d,X), X=0..lungime\_elipsa(a,b)/2,axes=none]); }$

$> \text{d2:=pointplot([[0,0],[lungime\_elipsa(a,b)/2,0]], connect=true); }$

$> \text{d3:=seq(pointplot([punctey[i],punctex[i]],symbol=CIRCLE, axes=none),i=1..2*m+3);display(d1,d2,d3, scaling=constrained); }$

$> \text{end proc; }$

$> \text{desen\_semi\_fus\_coarda\_vertical(2,1,6,3,1), Fig.8.}$
The procedure below draw vertically a fuse as well the points that determine it.

```plaintext
> desen_fus_coarda_vertical:=proc(a,b,n,m,d)
> local d1,d1s,d2,d3,d3s,punctex,punctey;
> punctex:=punte_fus(a,b,n,m);
> punctey:=punte_fus_coarda(a,b,n,m);
> d1:=plot([aproximare_coarda_semi_fus(a,b,n,m,d,X),
X,X=0..lungime_elipsa(a,b)/2],axes=none);
d1s:=plot([-aproximare_coarda_semi_fus(a,b,n,m,d,X),
X,X=0..lungime_elipsa(a,b)/2],axes=none);
> d2:=pointplot([[0,0],[0,lungime_elipsa(a,b)/2]], connect=true, linestyle=DASH);
> d3:=seq(pointplot([punctey[i],punctex[i]],symbol=CIRCLE,
axes=none),i=1..2*m+3);
d3s:=seq(pointplot([-punctey[i],punctex[i]],symbol=CIRCLE,axes=none),
i=1..2*m+3);
> display(d1,d1s,d2,d3,d3s, scaling=constrained);
> end proc;

> desen_fus_coarda_vertical(2,1,6,3,1), Fig.9.
```

Fig.7. A semi-fuse drawn horizontally. 
Fig.8. A semi-fuse drawn vertically.

Fig.9. A fuse drawn vertically.
The procedure \texttt{desen_desf_fus_coarda} draws the development of the developable surface that approximate the ellipsoid of revolution.

\begin{verbatim}
> desen_desf_fus_coarda:=proc(a,b,n,m,d)
>   local d1,d1s,d2,d3,d3s,punctex,punctey;
>   punctex:=puncte_fus(a,b,n,m);
>   punctey:=puncte_fus_coarda(a,b,n,m);
>   d1:=seq(plot([b*sin(Pi/n/2)+j*2*b*sin(Pi/n/2)+aproximare_coarda_semi_fus(a,b,n,m,d,X), X=0..lungime_elipsa(a,b)/2],axes=none),j=0..2*n-1);
>   d1s:=seq(plot([b*sin(Pi/n/2)+j*2*b*sin(Pi/n/2)-aproximare_coarda_semi_fus(a,b,n,m,d,X), X=0..lungime_elipsa(a,b)/2],axes=none),j=0..2*n-1);
>   d2:=seq(pointplot([b*sin(Pi/n/2)+j*2*b*sin(Pi/n/2),0],
>                     [b*sin(Pi/n/2)+j*2*b*sin(Pi/n/2),lungime_elipsa(a,b)/2], connect=true,linestyle=DASH),j=0..2*n-1);
>   d3:=seq(seq(pointplot([b*sin(Pi/n/2)+j*2*b*sin(Pi/n/2)+punctey[i],punctex[i]],symbol=CIRCLE,axes=none),i=1..2*m+3),j=0..2*n-1);
>   display(d1,d1s,d2,d3,d3s,scaling=constrained,axes=normal);
> end proc;

> desen_desf_fus_coarda(2,1,6,3,3);

Fig.10. The “development” of revolution ellipsoid (n=6, m=3, d=3)

> desen_desf_fus_coarda(2,1,6,3,1);
\end{verbatim}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{sample.png}
\caption{The “development” of revolution ellipsoid (n=6, m=3, d=3)}
\end{figure}
Fig.11. The “development” of revolution ellipsoid \((n=6, m=3, d=1)\)

Other particular cases associated to semi-axes \(a=2\) and \(b=1\)

- For \(n=12, m=3, d=3\):
  
  > eroare_fus_coarda_aproximare(2,1,12,3,3);

  \text{Aria suprafetei desfășurate prin fuse (coarde) (Area of the surface development approximation), 21.28892150}

  \text{Aria elipsoidului de rotatie (Ellipsoid of revolution surface area), 21.47843534}

  \text{Eroare absoluta (Absolute Error), 0.18951384}

  \text{Eroare relativa (Relative Error) (\%) 0.8823447192}
Fig. 12. The “development” of revolution ellipsoid (n=12, m=3, d=3)

- For: n=12, m=6, d=3

> eroare_fus_coarda_aproximare(2,1,12,6,3);

Aria suprafeței desfășurate prin fuse (coarde) (Area of the surface development approximation), 21.40523942
Aria elipsoidului de rotatie (Ellipsoid of revolution surface area), 21.47843534
Eroare absoluta (Absolute Error), 0.07319592
Eroare relativa (Relative Error) (%), 0.3407879524

> desen_desf_fus_coarda(2,1,12,6,3);
4. CONCLUSIONS

The computerized method proposed can be used when it is desired to obtain a more accurate “development” of the ellipsoid and a rigorous control of the errors of approximation.

The “development” of the ellipsoid by means of the computer-assisted method offers the possibility of obtaining greater accuracy because we can choose a convenient number of fuses, number of level planes, as well as spline function of various degrees to connect the points that define the fuses. In the case of the graphical method the number of fuses of the “development” is limited for reasons of clarity of the graphical representation.

References
NEW CHALLENGES IN OPTIMAL CONTROL THEORY

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Abstract: In this paper we study a linear quadratic (LQ) optimal control problem for infinite-dimensional SDEs with countably infinite MSs and MN. Sufficient conditions for the existence of an optimal control which belongs to a particular class of admissible controls and minimizes an infinite horizon LQ cost functional are given with the stabilizing solution of an associated Riccati differential equation (RDE). The problem of finding a stabilizing solution for this RDE is considerably hard since we work on infinite-dimensional, ordered Banach spaces and a numerical computation of global solutions for RDEs is still a great challenge. However we recall here the theoretical results that ensure the solvability of the proposed LQ optimal control problem.

Keywords: optimal control, Riccati differential equation, ordered Banach spaces

1. INTRODUCTION

Stochastic differential equations (SDEs) affected simultaneously by Markovian switching (MS) and multiplicative noise (MN) can model many physical systems which experience abrupt environmental shocks and changes of their configurations. Examples: the population and the economic systems as well as the power systems or the telecommunication systems. The last ones frequently suffer unpredictable structural changes caused by failures or repairs, connections or disconnections of the subsystems [1]. Our task is to minimize an infinite horizon quadratic cost functional associated with a class of linear SDEs with MS and MN.

Similar problems were discussed before in [2-4] for finite dimensional control systems and finite MSs. In [5] is considered a finite horizon LQ optimal control problem for SDEs with countably infinite MSs.

2. STATEMENT OF THE PROBLEM

Let $H, U, V$ be real separable Hilbert spaces. Then $L(H, U)$ is the space Banach (B)-space of all linear and bounded operators from $H$ to $U$ and $S(H)$ is the space of all self-adjoint operators from $L(H) := L(H, H)$. Let $Z$ be an interval of integers (finite or infinite) and $(B, \|\cdot\|)$ a real B-space. Then $L^g_Z$ denotes the real B-space $L^g_Z := \{g \in B | \sup_{i \in Z} \|g(i)\| < \infty \}$ endowed with the usual operations and the norm $\|g\|_Z$. (E.g.: for $B = S(H)$ we get the B-space $L^g_Z$). We say that $X \in L^g_Z$ is nonnegative if $X(i) \geq 0, i \in Z$. The cone $K_H$ of all nonnegative elements of $L^g_Z$ introduces an order $\geq$ on $L^g_Z$. A sequence
\[ X(t) \geq 0, t \in \mathcal{I} \) if there is \( \gamma > 0 \) such that \( X(t) \geq \gamma \Phi \) for all \( t \in \mathcal{I} \).

Here \( \Phi = (..I_H, I_H,..) \in L_2^\mathcal{I}(H) \) and \( I_H \) is the identity operator on \( H \). Let \( C_b(R_+, L_2^\mathcal{I}(H)) \) be the space of all continuous and bounded functions from \( R_+ \) to \( L_2^\mathcal{I}(H) \).

We note here that all the coefficients of the equations discussed below are elements of a space \( C_b(R_+, L_2^\mathcal{I}(H)) \).

Now let \( (\Omega, \mathcal{F}, P) \) be a complete probability space and \( \eta(t), t \in R_+ \) a right continuous, homogeneous Markov process on \( \Omega \) with the state space \( Z \), the standard transition probability matrix \( P(t) = (p_{ij}(t))_{i,j \in Z} \) and the infinitesimal matrix \( \Lambda = (\lambda_{ij})_{i,j \in Z} \) satisfying the condition

\[
0 \leq \lambda_{ij}, i, j \in Z, j \neq i, \sum_{j \in Z, j \neq i} \lambda_{ij} = \lambda_{ii} < c \text{ for all } i \in Z \text{ and some } c > 0;
\]

and let \( w(t) = (w_k(t))_{k=1,}^r, t \in R_+ \) be a standard \( r \)-dimensional Wiener process independent of \( \eta(t), t \in R_+ \).

In the sequel \( L_2^\mathcal{I}(\mathcal{H}) \) is the space of all \( H \)-valued stochastic processes \( X(t), t \in [a,b] \), that are nonanticipative with respect to \( \mathcal{H}_t \) and satisfy

\[
E[\int_a^b \|X(t)\|^2 \, dt] < \infty.
\]

Here \( \mathcal{H}_t \) is a normal filtration defined by the \( \sigma \)-algebras generated by \( \eta(t) \) and \( w(t) \) and \( E[.] \) denotes the mean (expectation) of a random variable.

The stochastic differential system with control \((A,B)\) considered in the sequel, is of the form

\[
\{X(t)\}_{t \geq 0} \subset L_2^\mathcal{I}(H)
\]

is uniformly positive

\[
dx(t) = [A_0(t,\eta(t))X(t) + B_0(t,\eta(t))u(t)] \, dt + \sum_{k=1}^r [A_k(t,\eta(t))X(t) + B_k(t,\eta(t))u(t)] \, dw_k(t).
\]

where

\[
A_k \in C_b(R_+, L_2^\mathcal{I}(H)), B_k \in C_b(R_+, L_2^\mathcal{I}(\mathcal{H})) \text{ for } k = 0,1,...,r
\]

and the control \( u = \{u(t)\}_{t \geq 0} \) belongs to \( L_2^\mathcal{I}(\mathcal{H}) \).

Here \( A_i(t,i) \) is the \( i \)-th component of \( A_i(t) \).

System \((A,B)\) without control \((B_k = 0, k = 1,...,r)\), will be denoted \( (A) \).

Assuming that

\[
\begin{pmatrix}
M(t) \\
D(t)
\end{pmatrix} \in C_b(R_+, L_2^\mathcal{I}(\mathcal{H}))
\]

our optimal control problem (O) consists in minimizing the performance

\[
J_1(u,t_0,x_0,i) = \int_{t_0}^T \left( E[\langle M(t,\eta(t))X(t),X(t) \rangle + 2\langle D(t,\eta(t))u(t),X(t) \rangle + \langle R(t,\eta(t))u(t),u(t) \rangle_{\eta(t,u)}] \right) \, dt,
\]

subject to \((A,B)\) over the set \( U_i(t_0,x_0) \) of all controls \( u = \{u(t)\}_{t \geq 0} \) with the property that \( u \in L_2^\mathcal{I}(\mathcal{H}) \) for all \( T > t_0 \), \( J_1(u,t_0,x_0,i) \) exists and is finite and

\[
\lim_{t \to \infty} E[\|X_a(t)\|^2_{\eta(t,u)}] < \infty.
\]

That is, we are looking for a control \( u \) which stabilizes \((A,B)\) and minimizes the cost function \( J_1 \).
3. OPTIMAL CONTROL PROBLEM

3.1 GLOBAL SOLVABILITY OF RICCATI DIFFERENTIAL EQUATIONS ASSOCIATED WITH THE OPTIMAL CONTROL PROBLEM

The Riccati differential equation (RDE) associated with (P1)-(P2) is of the following form.

\[
\frac{d}{dt} X(t) + A^*[t]X(t) + X(t)A(t) + \Pi_1(t, X(t)) + M(t) - R(t) = 0
\]

(3)

where

\[
A(t,i) = A_0(t,i) + \frac{\lambda_i}{2} I_{H}, \quad B(t,i) =
\]

\[
B_0(t,i), \Pi_1(t,X)(i) = \sum_{k=1}^{r} A_k(t,i)X(i)A_k(t,i) + \sum_{j=2}^{r} \lambda_{ij} X(j)
\]

\[
\Pi_1(t, X)(i) = \sum_{k=1}^{r} A_k(t,i)X(i)B_k(t,i), \Pi_1(t, X)(i) =
\]

\[
\sum_{k=1}^{r} A_k(t,i)X(i)B_k(t,i),
\]

\[
\Pi_2(t, X)(i) = \sum_{k=1}^{r} B_k(t,i)X(i)B_k(t,i),
\]

\[
i \in Z, t \in \mathbb{R}_+.
\]

The global solvability of the Riccati differential equation was studied in [6]. To state the main global solvability results we need some more definitions and notations. So, we define the dissipation operator

\[
D^z(t, X(t)) = \begin{pmatrix}
\frac{d}{dt}(t, X(t)) & d^z(t, X(t)) \\
d^z(t, X(t)) & R(t) + \Pi_2(t, X(t))
\end{pmatrix},
\]

\[
d^z(t, X(t)) = \frac{d}{dt}X(t) + A^*[t]X(t) + X(t)A(t) + M(t),
\]

\[
d^z(t, X(t)) = XXB(t) + \Pi_{12}(t, X(t)) + D(t).
\]

and the set

\[
\Gamma^z = \{X \in C_b([t_0, t_1]; \mathbb{R}^2) | R(t) + \Pi_2(t, x(t)) > 0, d^z(t, x(t)) \geq 0, t \in \mathbb{R}_+ \}.
\]

Definition 1 By a global solution of the RDE (3) we mean a mapping \(X \in C([t, t_1]; \mathbb{R}^2)\) that satisfies (3) and has the property that \(p(X(t), i) + \Pi_2(t, X(t))\) is invertible for all \(i \in Z, t \in \mathbb{R}_+\). A global solution \(X\) of (3) is called nonnegative if \(X(t) \geq 0\) for all \(t \in \mathbb{R}_+\).

Note that \(\Gamma^z\) contains all global and bounded solutions \(X \in C([t, t_1]; \mathbb{R}^2)\) of RDE (3) which verify the following condition \(R(t) + \Pi_2(t, X(t)) > 0, t \in \mathbb{R}_+\).

Definition 2 A global and bounded solution \(X \in C([t, t_1]; \mathbb{R}^2)\) of (3) is called maximal if \(X(t) \geq Y(t), t \in \mathbb{R}_+\) for arbitrary \(Y \in \Gamma^z\).

Definition 3 We say that a global solution \(X\) of the RDE (3) is stabilizing if the mapping \(F(t) = -[R(t) + \Pi_2(t, X)] \in \mathbb{R}^2\) is a stabilizing feedback gain for \((A, B)\). We shall say that \(F(t)\) is the stabilizing feedback gain defined by the solution of the RDE. We recall the following.

Definition 4 A mapping \(W \in C_b([t_0, t_1]; \mathbb{R}^2)\) is a stabilizing feedback gain for the control system \((A, B)\) if the stochastic differential equation \((A + BW)\) is uniformly exponentially stable in conditional mean (UESCM). Then \((A, B)\) is said to be stochastic stabilizable.

Definition 5 The SDE \((A)\) is UESCM if there are \(\beta \geq 1\) and \(\alpha \in (0, 1)\) such that the unique solution \(x(t)\) of \((A)\) that satisfies the initial condition \(x(t_0) = x \in H\) has the property

\[
E\|x(t)\|^2 I_{\{x(t)\leq 0\}} \leq \beta \alpha^{1-\alpha} \|x\|^2,
\]

for all \(t \geq t_0 \geq 0, x \in H, i \in Z\).

Combining Corollary 20 from [7] and Theorem 13 from [6] we get the following sufficient conditions for the existence of
maximal solution.

**Theorem 1.** Assume that \((A, B)\) is stochastic stabilizable. Then the following are equivalent:

(i) \(\Gamma^z \neq \emptyset\);

(ii) The RDE (3) has a maximal solution \(X_{\text{max}} \in C_b^1(R_+, L^2(H))\) satisfying the uniform positiveness property \(R(t) + \Pi_2(t) X_{\text{max}}(t) > 0, t \in R_+\).

3.2 SOLUTION OF PROBLEM (O)

If the system \((A, B)\) is stochastic stabilizable and the set \(\Gamma^z\) is not empty, then the LQ optimization problem (O) is well posed. Moreover,

\[
\inf_{u \in U(t_0, x_0)} J_1(u, t_0, x_0, i) = \langle X_{\text{max}}(t_0, i)x_0, x_0 \rangle,
\]

where \(X_{\text{max}}\) is the maximal solution of the RDE.

**Bibliography**


TREND IN SUSTAINABLE HYDROPOWER DEVELOPMENT IN GORJ

CRISTINA IONICI, Constantin Brâncuși University, Târgu - Jiu, ROMANIA

Abstract: One of the crucial issues of sustainable development of hydropower is limited resource conservation and particularly energy without the maintenance and evolution of human civilization is inconceivable. Solution principle adopted at national level and therefore the county Gorj scale use increasingly broader renewable energy resources. The development in Gorj county is considering the use of fittings with small hydro schemes.

Keywords: hydropower, renewable resources, planning schemes, small hydro

1. INTRODUCTION

Hydraulic power water Oaca an important role at the beginning of the Industrial Revolution, technological progress, including the design of water turbines and generators good yield, in the nineteenth century, simultaneously with increasing demand for electricity in the early twentieth century, have turned the attention of consumers by hydropower development. In addressing the development of hydropower sector in Romania had in view the need to create structures that adapt to the European single market, in which national markets gradually loses its traditional boundaries, becoming an integral part of the common market.

The resources available are still high: the world only 14% of hydropower potential is arranged, and in Romania is arranged by approximately 40%. Developed countries have arranged large-scale potential (almost entirely in Switzerland, France and Italy, 67% in Japan, 55% in the US and Canada) and some countries use almost exclusively hydropower (Norway over 99%), although and other resources available. In order to integrate into the European Union, Romania will have to make further efforts to capitalize micropotенţialului to meet the EU Directive on renewable energy. The weather and geographical conditions of Romania, in the energy balance in the medium and long term are considered the following types of renewable energy sources (RES) energy: solar, wind, hydro, biomass and geothermal energy.

2. EVOLUTION OF POWER PLANT IN THE COUNTY OF GORJ

Renewable energy sources play an important energy potential and delivers unlimited local usage and naţional.Ele ensure increased safety of energy supply and to limit the import of energy resources, in terms of sustainable hydropower durabile.Energia its natural form is clean, Figure 1. The natural form of hydraulic energy. [3,4]
In recent years 2008-2014 ANRE sources [11,13] there is a demand for cheap electricity, hence hydro power production remains in 2nd place with a percentage of 26.64%, according to Table 2.

### Table 2. Energy Production

<table>
<thead>
<tr>
<th>YEAR</th>
<th>CHARCOAL TWh</th>
<th>%</th>
<th>WIND TWh</th>
<th>%</th>
<th>NUCLEAR TWh</th>
<th>%</th>
<th>HYDRO TWh</th>
<th>%</th>
<th>TOTAL PRODUCTION TWh</th>
<th>CONSUMPTION TWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>27.5</td>
<td>42</td>
<td>2.9</td>
<td>13</td>
<td>11.2</td>
<td>17</td>
<td>17.1</td>
<td>26</td>
<td>58.8</td>
<td>60.3</td>
</tr>
<tr>
<td>2009</td>
<td>26.7</td>
<td>43</td>
<td>11</td>
<td>18</td>
<td>13</td>
<td>15</td>
<td>15.9</td>
<td>26</td>
<td>66.6</td>
<td>59.2</td>
</tr>
<tr>
<td>2010</td>
<td>26.9</td>
<td>43</td>
<td>11.5</td>
<td>18</td>
<td>9</td>
<td>18</td>
<td>18.3</td>
<td>29</td>
<td>65.7</td>
<td>58.1</td>
</tr>
<tr>
<td>2011</td>
<td>23.5</td>
<td>41</td>
<td>10.3</td>
<td>20</td>
<td>9</td>
<td>20</td>
<td>20.2</td>
<td>34</td>
<td>63</td>
<td>55.8</td>
</tr>
<tr>
<td>2012</td>
<td>23.5</td>
<td>41</td>
<td>19.3</td>
<td>20</td>
<td>9</td>
<td>20</td>
<td>20.2</td>
<td>34</td>
<td>63</td>
<td>56.8</td>
</tr>
<tr>
<td>2013</td>
<td>21.5</td>
<td>39</td>
<td>20</td>
<td>20</td>
<td>9</td>
<td>20</td>
<td>20.2</td>
<td>34</td>
<td>63</td>
<td>51.8</td>
</tr>
<tr>
<td>2014</td>
<td>23.5</td>
<td>40</td>
<td>24.3</td>
<td>25</td>
<td>9</td>
<td>20</td>
<td>20.2</td>
<td>34</td>
<td>63</td>
<td>49.8</td>
</tr>
</tbody>
</table>

Thus to Gorj county planning there are several schemes in the form of micro (MHC) that the Livezeni-Bumbești-Tg. Jiu are located in Cascade lakes comprising 5: Sadu Valley, CARTIU, Turcinești, Vădeni and Tg. Jiu. Hydrological study of the course revealed Jiu opportunity of planning gorge hydropower sector between Livezeni - Sadu Valley Planning plant Dumitrita decision criteria in this state:

- harnessing the hydropower potential of this sector, that drive to reduce energy production based on fossil resources or improve national energy balance in a sustainable development perspective;
- adjacent development related activities, tourism, leisure and local industries.

In the county of Gorj its renewable electricity production in recent years by processing data from Romanian Waters SA, show an increase in production although at the.
Using water potential is closely linked to economic and social development of the society through the three major current issues:
- energy by producing electricity on account of hydraulic energy;
- nutrition by enriching the amount of water downstream hydroelectric facilities and irrigation system;
- to the surroundings, water is one of the environmental factors exhaustible and threatened by pollution.

Hydropower is complex hydraulic structures running both use water resources for various purposes, and i for combating any water. For their implementation, the use of water is intended for the following purposes:
- drinking and industrial water supply;
- electrică producerea electrical energy production;
- flood control;
- defense works and drainage, irrigation;
- development of water transport fish and water sports;
- improving the microclimate and environment. The social impact is extremely important economically, is a positive impact on the economy at county or national supply of electricity to the national electricity system. We can say that is born a positive and a negative, positive, affects the local economy because energy produced enable the development of their specific industries in the area. The positive:
- substantially improve living conditions by providing infrastructure (road networks, railways, power lines, telephone networks);
- improve living conditions through the creation and housing construction;
- developing tourism areas;
- Ensures an increase in jobs for the working population.

The negative aspect of the production of an impact lead to irreversible:
- long-term effect of disruption to transport sediments from upstream to downstream; biological environmental effect by altering the hydrological regime Jiu River;
- appears on agriculture in areas where the groundwater cant occur due to increased flood water.

3. CONCLUSIONS

In the current context is imperative to the continuous analysis of water resource thus proved the need to establish strategies to protect them because ignoring depreciation and declining resources that result in decreased quality of life, figure 4.
Note that small hydro schemes of arrangement may be made in certain sectors of the river will be improved and finalized on the basis of technical and economic analysis in which variants will be compared to planning permits and field hydrological conditions:

- Small hydropower units can be independent of electricity production that is part of the private sector which can compete with state and private producers (existing) electricity in the area.
- The main purpose of these private producers reclamation domestic renewable resources provided mainly by waterways small and very small, not included in planning large hydropower schemes.
- In general, small hydropower hydropower are local nature, the effect is relatively low environmental impact.
- If the goal is to operate microhydrocentralei network, then it must be established before the national operator protection system and measuring equipment, it must also estimate the cost of connecting to the network and that would be the best location in the system coupling.

- SHP projects are cost effective for a sale price of electricity between 20 Euro / MWh and 36,6Euro / MWh.

In the current context in the county Gorj following main features can be highlighted regarding the sustainable development of hydropower:

- Suitable for low power requirements, decentralized (light industry, private farms and businesses, rural communities) and external operations of the main network.
- Requires low voltage distribution networks and possibly sub micro-networks.
- Can be used on private property in joint ownership or joint ownership, with a need for semi-skilled labor and a common administration.
- brief period of construction with local materials and using abilities population in the area, may have a considerable impact on quality of rural life.
- Their flexibility as regards adaptation to varying loads depending on tributary flow, making them a prime component in any integrated energy system.
- Investments in small hydro proved to be safe for several decades.
References
TREATMENT OF DRILLING MUD FROM THE WASTE SPECIFIC TO OGRA, MURES COUNTY AND IDENTIFY THE CHARACTERISTICS OF THE GROUNDWATER

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Abstract: The paper describes the composition of one environmental factor, namely groundwater, which is monitored at the specific waste deposit in Ogra. Due to the modern processing technology of the drilling mud resulted from natural gas extraction, in the specific waste deposit in Ogra, Mures county, as well as to the treating method of these wastes using a specific recipe and to the safety measures consisting in the impermeabilization of this deposit, a minimum environmental impact of the treated and deposited wastes is ensured [1]. In order to determine the indices analyzed in the laboratory, some witness samples from the underground water in the control shaft and the respective collected leachate were sampled. According to the results of these analyses, the wastes’ aggressiveness towards the groundwater-soil complex can be established.

Keywords: hydropower, renewable resources, planning schemes, small hydro

1. INTRODUCTION

Romgaz operates a non-dangerous waste deposit resulted from the drilling activities, namely the Ogra waste deposit. This deposit was built on a former gravel pit, having a 20-year concession and it consists in a waste conditioning installation and two cells for unloading the wastes [2]. The groundwater’s quality is monitored every three months (for example the pH, chemical consumption of oxygen (CCO), chlorides, total dissolved solids, substances extractable with organic solvents, petroleum products and total chrome).

2. MATERIAL AND METHOD

In January, May, June and October 2014, the groundwater monitoring in the Ogra waste deposit was made in order to determine the environmental impact of the processing and deposition of the drilling mud resulted from natural gas extraction. The results of the monitored parameters are shown in Table 1. Renewable energy sources play an important energy potential and delivers unlimited local usage and national. Ele ensure increased safety of energy supply and to limit the import of energy resources, in terms of sustainable hydropower durabile. Energia its natural form is clean, Figure 1. The natural form of hydraulic energy. [3,4]
Table 1. Results of the monitored parameters in groundwater, in the Ogra deposit [3, 4]

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ph</td>
<td>pH units</td>
<td>7,3 6,22 6,75 6,92</td>
<td>-</td>
<td>6,5-8,5</td>
</tr>
<tr>
<td>Chlorides</td>
<td>mg/l</td>
<td>480 286 310 239 421</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>CCO-Cr</td>
<td>mg O2/l</td>
<td>42,64 69 62,4 30,15</td>
<td>-</td>
<td>70</td>
</tr>
<tr>
<td>Petroleum products</td>
<td>mg/l</td>
<td>0 0 0 0</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>Extractable</td>
<td>mg/l</td>
<td>0 0 0 0</td>
<td>-</td>
<td>20</td>
</tr>
<tr>
<td>Total chrome</td>
<td>mg/l</td>
<td>0,77 0,910 0,02 0</td>
<td>50(μg/l)</td>
<td>1,0</td>
</tr>
<tr>
<td>Filtered residue</td>
<td>mg/l</td>
<td>892 1130 1280 968 2480</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

3. RESULTS AND DISCUSSIONS

Observing the results obtained from the groundwater samples, it can be seen that the analyses results are below the maximum accepted limit imposed by NTPA 001/2002, with subsequent modifications [5].

Comparing the obtained results for the analyzed indices with the norm values imposed by Law 458/2002 [3] regarding drinking water quality, it can be observed that the limit imposed for chlorides is exceeded. In addition, by analyzing a witness sample from a well situated about 1 km downhill of the deposit, it can be seen that the value obtained for the chlorides is more or less equal with the values obtained for the monitored groundwater samples, which proves that the natural phreatic resource in the area contains a higher amount of chlorides. Considering that in the draining network and leachate collection network there are no losses and also considering the impermeabilization of the deposit, it is unlikely that this parameter be exceeded as the result of the activity in the deposit [6]. The results of the monitored parameters are shown in Table 2.
Table 2. Results of the monitored parameters in leachate, in the Ogra deposit [3, 4]

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>ph</td>
<td>Unitat de pH</td>
<td>6.78</td>
<td>-</td>
<td>6.5-8.5</td>
</tr>
<tr>
<td>Chlorides</td>
<td>mg/l</td>
<td>480</td>
<td>250</td>
<td>500</td>
</tr>
<tr>
<td>CCO-Cr</td>
<td>mg O2/l</td>
<td>15.27</td>
<td>-</td>
<td>70</td>
</tr>
<tr>
<td>Petroleum products</td>
<td>mg/l</td>
<td>0</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>Extractable</td>
<td></td>
<td>0</td>
<td>-</td>
<td>20</td>
</tr>
<tr>
<td>substances</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total chrome</td>
<td>mg/l</td>
<td>0</td>
<td>50(µg/l)</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Analyzing the above data it can be concluded that there were no significant modifications of the pollutants' concentrations, either in the groundwater sampled from the control borehole or in the collected leachate.

Currently, the stabilization of the specific waste resulted from the methane gas extraction activity (detritus and contaminated drilling fluid) is accomplished using a method proposed by S.C. Fitpol S.A. Bucharest [7], with the following recipe:

- 1.000 dm³ waste (contaminated drilling fluid and detritus, in equal portions)
- 200g cement S1 or S2RRS;
- 1g NaOH

The fee for controlled elimination of specific wastes using this method is 29 euro/m³. Test results are presented in Table 3.

Table 3. Results obtained from the tests

<table>
<thead>
<tr>
<th>Old technique [8]</th>
<th>New technique [8]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processing batch:</td>
<td>For the same quantity of processed waste, the materials used for solidification-stabilization are:</td>
</tr>
<tr>
<td>-40 mc(20 mc detritus+20mc used fluid)</td>
<td>-40mc waste</td>
</tr>
<tr>
<td>-6 t cement</td>
<td>-40kg NaOH dissolved in 200 l water</td>
</tr>
<tr>
<td>-40 kg NaOH</td>
<td>-4.500kg cement</td>
</tr>
<tr>
<td></td>
<td>-1.700 kg plaster</td>
</tr>
</tbody>
</table>

Obtaining a material which can be assimilated with hard soil.
Costs for batch process: 18.480 lei

For the same quantity of processed waste, the materials used for solidification-stabilization are:

- 40mc waste
- 40kg NaOH dissolved in 200 l water
- 4.500kg cement
- 1.700 kg plaster

The materials used for solidification-stabilization are commonly used in construction and do not require special handling methods. Using the same technology there can be incorporated other types of wastes in the mass of the stabilized material. The achieving of important benefits by diminishing the technological cost, due to the inminishing of the cement quantity used (plaster is a material with a relatively low price).
Cost for batch process: 16.900 lei.
Possibility of accepting other types of wastes from third parties to be deposited, applying a fee.
4. CONCLUSIONS

By presenting the buffer deposit in Ogra and the two tests conducted by Lafarge Romcim in the Hoghiz factory, I wish to emphasize the importance of the environmental policies adopted and applied by the above-mentioned institution in the case of the impact of the wastes generated by using the drilling fluid. The Romanian industry has started to be aware that the environment protection must be seen as a factor competitiveness. This imposes the development of clean technologies and products which will have an effect upon the minimizing of the environmental costs growth and will stimulate a more rapid implementation of the scientific research and technological development results. Here applies the concept of „clean drilling process”, rendered in scheme 1 [9].

The environmental impact of the specific activities is reduced due to the methods taken, of which we can mention: the use of a closed and safe system for the surface drilling fluid circuit, for the wastewaters and detritus; the cleaning of the drilling fluid which enabled the reduction of the total mud volume used at a drill; mud and residual waters recycling by adding coagulants and floculants followed by the mechanical separation of the solid particles; the replacement of the components and additives, lubricants, corrosion inhibitors with high toxicity with other substances less toxic; the elimination of residual waters by injection under the deep water level; the use of biodegradable additives and foams; the use of barite with a low content of Hg and Cd; avoiding the discharge of residual waters in natural receptors; the use of drilling muds with high LC50 (800000-1000000 ppm) and their biological testing; the ecological reconstruction of the establishments temporarily used.

After finishing the drilling activities and the production samples or the starting of the drill production (in the case of exploitation drills) the drilling installation is dismantled, the installation, annexes and other buildings are evacuated.

The soil is cleaned of the terrace materials and wastes:
sterile resulted from detritus
- concrete tiles
- metal tanks and concrete caissons
- pavements, collecting and protection networks
- fencing materials of the drill’s area
- gravel materials

The drill’s area and temporary access roads (cleaned of terrace material) are chiseled and repurposed according to the initial configuration of the used terrain.

The layer of fertile soil is uniformly spread and leveled.

The soil is fertilized with natural fertilizers (acc. To the project plan) and the terrain is ploughed.

REFERENCES


Soil samples are collected and the quality is compared with the analyses conducted before the surface activity started.

The terrain is handed over to its owners with an official report, endorsed by legal representatives according to the current legislation.

5. ACKNOWLEDGEMENTS

This paper was completed with the help of S.N.G.N. Romgaz S.A. Mediaş and Prof.Dr.Engineer Tiberiu Rusu, Technical University of Cluj- Napoca.

[8] Documentation of the environment of exploration and mining probes within its 2013 SNGN ROMGAZ SA
Abstract: This paper is an analysis of how the energy system in Romania influence sustainable development. It is known that the energy sector is one of the basic pillars of our economy. Permanent development of this sector leads to economic development, Romania still having many energy resources.

Keywords: hydropower, renewable resources, planning schemes, small hydro

1. INTRODUCTION

Energy is essential for life on Earth. It exists everywhere and is due to the occurrence of many phenomena: motion, light, sound, heat, etc. There are several forms of energy, but almost all energy on Earth comes directly or indirectly from Sun. Contrast to artificial sources of energy, man obtained by converting one form of energy into another form of energy are sources of primary energy sources. Existing energy in nature and can be used directly.

Society today is a major consumer of energy in various forms, in industry, transport, agriculture, etc. In the household Energy consumption per person is considered an indicator of the level of living standards. Growth can not take place without a corresponding increase energy consumption.

Discovering new sources of energy has enabled man to move to higher stages of development, characterized by increasing productivity, technical performance, level of comfort by decreasing pollution.

Accelerated development of global industry has increased the emission of pollutants into the air that have a negative impact on flora and fauna. Currently it seems that environmental pollution by uncontrolled human activity is approaching "critical threshold" beyond the limits of nature protection, placing in danger the existence of life on Earth.

Global warming caused by the greenhouse effect amplification is the most visible sign of climate change occurring across the entire globe. Increased frequency of extreme weather events (floods, storms, excessive heat), melting glaciers and rising sea levels represent serious threats to the environment and human health.[1]

Thus, it stressed the need to develop national and international policies aimed at environmental protection in order not to compromise the quality of life of future generations and of all living species on this planet. Environmental policies have been strengthened by legislative measures.

And Romania due to industrial activities developed, particularly in the energy
sector is one of the countries affected by all these negative effects on the environment. [2]

One of the main problems the solution of which depends on the development of our civilization, the issue has returned to the forefront of concerns scientists is providing the energy needed to develop basic activities, which conditions progressive evolution of the living standard of the population Globe.

Authorities are trying to reduce EU energy waste by informing europeans and the gradual introduction of alternative energy sources, which are not in our country polluting. Experts search solutions, but encounter more difficulties than other states Europe.

2. SUSTAINABLE DEVELOPMENT THROUGH ENERGY EFFICIENCY

Energy efficiency must become a priority for Romania. In this context, there are several courses of action:
- Develop a national strategy for the implementation of specific regulations and improving the institutional framework in order to attach due importance to energy efficiency;
- Raising awareness of all stakeholders, accompanied by a policy of voluntary funding.

Energy efficiency is a prerequisite for sustainable development. [3]

To ensure sustainable economic growth [5], must:
- to develop a more competitive economy with low CO₂ emissions, to use resources efficiently and sustainably;
- protect the environment, reduce emissions of greenhouse gases and to stop biodiversity loss;
- take advantage of Europe's position as a leader in developing new technologies and environmentally friendly production methods;
- to introduce smart electricity grids and efficient;
- European networks to tap small producers to give them additional competitive advantage;
- improve the business environment;
- to help consumers choose products and services, knowingly.

EU objectives for sustainable growth:
1. 20% reduction by 2020, emissions of greenhouse gases to 1990 levels - the EU is willing to reduce emissions as much as 30%, provided that other developed countries make comparable commitments and Developing countries contribute, where possible, within a global agreement;
2. increase the share of renewables to 20%;
3. increase by up to 20% energy efficiency.

hydropower durabile.Energia its natural form is clean, Figure 1. The natural form of hydraulic energy. [3,4]
Legend: I. Delta (solar) ; II . Dobrogea (solar and wind) ; III . Moldova (plains and plateaus - micro hydro, wind and biomass) ; IV . Carpathian Mountains (IV1 - Eastern Carpathians, IV2 - South Carpathians, IV3 - Western Carpathians (biomass, micro hydro)); V. Transylvania (micro hydro) ; VI. Western Plain (geothermal energy) VII. Subcarpații (VII1 - Subcarpații Getici; VII2 - Subcarpații Bend; VII3 - Subcarpații Moldova: biomass, micro hydro) VIII. South Plain (biomass, geothermal and solar). [4]

We foster sustainable development, as follows:

1. An effective development in terms of energy resource by:
   - a reduction of CO$_2$ emissions;
   - improving energy security;
   - a reduction in the amount of resources used.

2. An industrial policy for the globalization era:
   - a support entrepreneurship for European companies to become more efficient and competitive;
   - one covering all elements of the value chain increasingly globalized, from access to raw materials to after-sales service.

Such a policy can only be developed in close cooperation with businesses, trade unions, academics, ONG and consumer organizations. Sustainable growth [5] is necessary because at the moment we depend so much on oil, gas and coal, which has the effect of:

- exposure of consumers and businesses to price fluctuations;
- threatens our economic security;
- contribute to climate change.

Competition for natural resources will intensify globally and put pressure on the environment. Sustainable development policy of the European Union can help reduce these pressures.

To achieve the objectives of combating climate change, we must accelerate the pace of reducing emissions and exploiting new technologies (wind and solar energy, carbon capture and storage, etc.).

We also need to strengthen the resilience of economies in the face of climate risk and...
disaster prevention capacity and respond to them.

3. CONCLUSIONS

To increase competitiveness should meet the following objectives:
• Romania must improve its productivity and competitiveness and maintain its position in green technologies;
• Achieving European energy we would save, by 2020, 60 billion on imports of oil and gas. Besides the economic advantage, this would allow us to improve our energy security.
• An increased level of integration of the European energy market could contribute to an increase in EU GDP by 0.6 % to 0.8 %;
• If the European Union would increase the share of renewables to 20 % could be created 600 000 new jobs - and other 400 000 if reached the 20 % energy efficiency;
• It is necessary to ensure that measures to reduce emissions take into account to maximize the benefits and minimize the costs, including the use of innovative technical solutions.

References
1. Lăzăroiu, Gh.- Protecția atmosferei împotriva poluării, Editura Printech, București 1998
ON A WAY OF IMPLEMENTING THE “NATIONAL STRATEGY FOR RESEARCH, DEVELOPMENT AND INNOVATION” IN THE DISCIPLINE PHYSICS

POPESCU GEORGE, ADINA TĂTAR, ADRIANA FOANE, 
Constantin Brâncuși University of Târgu Jiu, ROMANIA

Abstract: The objective consists in improving the attractiveness discipline by highlighting the fundamental paths and applied research to use in future engineers directly, without overlapping with the knowledge received specialized disciplines.

Key words: physics, discipline, science.

1. TRADITIONAL PHYSICS AND ITS SHORTCOMINGS

Until after 2000, subject "Physics" was considered an avid discipline, with many formulas whose understanding requires mathematical skills above average:
- Resumption of the high and mighty of chapters devoted to mathematical environment, considered classics, Macan, thermodynamics.
These were among the reasons for which the minimum hours and the importance attributed discipline were reduced considerably, although in the last broadcast interview, Remus Răduleţ academician, said that the "pillars" on which are formed an engineer Physics, Mathematics and Materials Science.[1]
The opinions "against" discipline manifested in two directions:
- Most of the production engineers claimed that over 90% of assimilated knowledge are useless:
- From teachers lineup professed engineering physics is not necessary, since the physical elements required are included in the introductory part of the course with technical specifications.[3]

2. REVIEWING THE APPROACH TO DISCIPLINE

Under the name "Physics" is actually hiding a huge number of branches of research and development with direct applicability in engineering sometimes that can be presented to students in the contexts of "energy -environment" or "new and emerging technologies."[4]
In the context of restricting the curriculum in one semester and to eliminate contradictions mentioned above, we chose to present within discipline in those areas of knowledge - other than those considered classics - so as to win acceptable skills in areas such as:
- Magnetic fluid physics, physical foundations of the theory of sonics, nuclear radiation and protection against impacts, non-ionizing radiation and electromagnetic energy capture notions of systems far from equilibrium thermodynamics, holographic universe.
In this way they can be brought into the light of knowledge advanced nation that were designed just a few years ago. For example, the concepts of holographic universe and multiverse is circulated in physics in 2012, and familiarity with fundamental nations in modern fields bring us certainly implicit acceptance XXI century physics.[2]

3. CONCLUSION

There have already been established fundamental directions of development of applied cognitive science of the future:
- Artificial intelligence, systems theory, fractal theory and chaos theory, so science to give definitive mechanistic concepts such as circulating now.
These predictions bandied by the big names of modern science in recent years have I considered necessary to accommodate changing scientific vision of the future graduates, people who will have to face a completely computerized society, in which the above concepts that will turn into the usual notions.

References
1. Teoria curricumului- Marcel Caprescu
DEVELOPMENT OF A DIDACTIC STRATEGY OF TEACHING – LEARNING – EVALUATION FOR „THE POLLUTION OF THE ENVIRONMENTAL FACTORS„ SUBJECT

ROXANA GABRIELA POPA, IRINA RAMONA PECINGINA,
Constantin Brâncuși University of Târgu Jiu, ROMANIA

Abstract: The work presents the development of a didactic strategy for the „The pollution of the environmental factors” subject and the possibility of approach in the case of the teaching – learning – evaluation act. The design of the didactic strategy is based on the combination of the methods, means and forms of the didactic act organisation and on the programming of the held process steps, while respecting the principles and the rules of the teaching staff. The task of the didactic strategy for „The pollution of the environmental factors” subject consists in the ensuring of the achievement of the education process on the three components: informational, psychological and cybernetics. In addressing of the didactic strategy it takes into account the interactions of the four factors: the personality of the university teacher, the personality of the student, the education content and the education process. The goal of the didactic strategy is to optimize the process of teaching – learning – evaluation in the context of „The pollution of the environmental factors” subject, taking into account: the optimal selection of the methods, procedures and means, the creation of the achievement of the competences and sub-competences adequate to the learning contents, the ensuring of the effective didactic communication, the motivation and the development of the student interests, linking the theory with the practical activities. The elaboration and the adoption of a didactic strategy is a complicated process from the point of analytical-syntetical and action view and a complex one from the point of the multitude factors which determines its validity (the linking with the competences, sub-competences, the curricular objectives of „The environmental engineering” domain, the content of the learning subject, the personality features of the students, the typology of the courses, the self-study orientation, the applied and practical aspects orientation, the field of the welfare and the motives of the students).

Keywords: didactic strategy; teaching; learning; subject; environmental

1. CHARACTERISTICS OF A DIDACTIC STRATEGY FOR THE DISCIPLINE „THE POLLUTION OF THE ENVIRONMENTAL FACTORS"

The word strategy originates in greek language from the word strategic = to lead an army, extended in the educational domain with the significance of: the planning art of leading a complex process, based on of long standing, veridical and realistic prognosis.

Didactic strategy = a coherent and complex process of means, methods, materials and other educational resources which aims at achieving some purposes [1].

For the discipline The pollution of the environmental factors, a speciality discipline absolutely necessary to the students which are on the syllabus in the Environment engineering domain, the educational strategy plays first fiddle in teaching-learning-evaluation activity, because the designing and the organization of the didactic activity related to the classes and laboratories, is
realized based on the strategical decision of the don. The don conceives and applies an didactic strategy, namely a complex didactic screenplay which includes the teaching-learning-evaluation players, the conditions by which they are to be achieved, the purposes and the methods which are to be aimed.

The didactic strategy concept for the discipline The pollution of the environmental factors is based on three aspects:

- the learning approach (for example: the heuristic problematization)
- the combination way of the methods, means and organization forms of the didactic act
- the programming way (selection, ordering, ranking) in an optimal sequence of the phases and stages (of the events) specific to the process carried on in the class and in the laboratory, with the definition of time and with the abidance by the didactic principles and rules [2].

The characteristics of the didactic strategy which have to be elaborated and designed in the Pollution of the environment factors discipline are:

- the involvement of the students in specific situations of learning
- the rationing and the adaptation of the instruction content based on the psycho-individual characteristics of the students
- creating a premise for the optimal manifestation of the interaction between the other components of the instruction process
- the contextual combining, original and unique of the elements of the didactic-educational process

For the discipline The pollution of the environmental factors can be elaborated and designed the following types of didactic strategies:

- **inductives** – the didactic intercession is done from particular to general
- **deductives** – inverted to the inductives, that is from general to particular, which is incarnated using examples
- **analogues** – the teaching and learning are done using the models
- **mixed** - inductives-deductives and deductives-inductives
- **algorithmics** – explanatory-demonstratives, intuitives, exposes, mimetics, programmed and algorithmics their own
- **heuristics** – elaborating the knowledges under one’s own thinking effort, using the problematization, the discovery, the modelling, the wording of the hypothesis, the heuristic dialogue, the investigation experiment, the assault of the ideas and which have as effect the stimulation of the creativity [4]

Based on criteria, the didactic strategies are classified according to the table 1:
Table 1. Classification of the didactic strategies related to the criteria

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Strategy type</th>
</tr>
</thead>
<tbody>
<tr>
<td>The domain of the adjacent training contents</td>
<td>• cognitive&lt;br&gt;• psychomotors&lt;br&gt;• emotional-attitudional&lt;br&gt;• mixed</td>
</tr>
<tr>
<td>Prevailing cognitive operations</td>
<td>• inductives (from practical to abstract)&lt;br&gt;• deductives (from abstract to practical)&lt;br&gt;• analogues (based on modelling)&lt;br&gt;• transductives (by drawing on more sophisticated reasonings of essayistical and figurative nature, language games)&lt;br&gt;• mixed (consist in inductive and deductive approaches)</td>
</tr>
<tr>
<td>The guidance or nonguidance level of the learning</td>
<td>• algorithmics (impose a very strictly guidance of the learning, using as methods the algorithmic and the programmed learning)&lt;br&gt;• semialgorithmics (of half-independent learning)&lt;br&gt;• nonalgorithmics or heuristics (minimal guidance, the accent on the independent learning, based on discovery and research and on problem solutions)</td>
</tr>
</tbody>
</table>

The task of the didactic strategy for the subject The pollution of the environmental factors consists in the assuring of the accomplishing of the training process on the three components:

- informational – the transfer of the information, its receiving and reception, the accumulation, the transformation, the preservation and the use of the information throughout vocational training of the students
- psychological – the training and the development of the human personality of the students
- cybernetics – the guidance of the cognitive activity of the students

The weighting of each component is a proportion subordinated to the relation of society-student, aspect which is taken in account when apply the specificity of the used didactic strategy.

The classical strategies correlated to a society with stable social and economical relationships and with aspects of planned environmental protection are centred on the informational component. These strategies assure the abidance by the internal logic of the discipline, which is an appropriation of the fundamental bases of the sciences and has the role to figure in the training of the specialists which will activate very well in invariable conditions, practitioners which will accomodate to a society characterised by dynamism, informational explosion due to the implementation of the advanced technologies, globalization, economical crisis, changes of social-human relationships [5].

The contemporary work market asks for universal practitioners which enable to change, quickly and effective, the domain and type of activity, with abilities of cooperation-development, good team-workers, but with leadership competences, as well, which can take independent decisions, to have plenty of initiative and ingenuity, to be competents and
competitives. These requirements, as well as the demographic growth and implicitly the variation of the polluting sources and of the resulted pollutants which produce effects to the environment and to the human body health, impose the creation of a new and modern didactic strategies, centred on the active and interactive learning, which have as goal the training of the knowledges and of the functional competences. The modern didactic strategies do not oppose to the classical strategies and they do not minimize the role of the acquired knowledges, but guide them to a new aim, imprint them an active and functional character. To this end, the knowledges will be transformed from the finality of the didactic process in a resolving tool of different problem-situations.

The don uses a didactic strategy starting from the concept that, the didactic method aims to an activity of teaching-learning-evaluation, and the strategy aims to the training process on the whole and not to a training sequence.

2. DIDACTIC METHODOLOGIES FOR THE DISCIPLINE „THE POLLUTION OF THE ENVIRONMENTAL FACTORS"

The didactic methodologies applied in a didactic strategy which reckon the work market requirements are informative, active-participative, of individual study, of checking and of evaluation.

The methods of teaching-learning-evaluation used in the discipline The pollution of the environmental factors represent:

- Action plans which include a sequence of operations achieved for attaining the goal
- Work instruments in the training and knowledge activity of the skills
- Technics by which the dons and the students use it to accomplish the teachin-learning-evaluation action and which assure by putting into practice of a mental designed activity according to the didactic strategy.
- Methods whereby the students gain in the educational process, under the coordination of dons, to acquire knowledges and skills, to develop the intelectual capacities and to capitalize on specific aptitudes.

The functions of the teaching-learning-evaluation methods are:

- cognitive – of guidance the knowledge to assimilate some knowledges
- normatives – consist in methodological aspects
- motivational – of stimulation of the cognitive interest and of supporting of the learning process
- training-educational-compensatory- of practising, training and developing the psychic processes [6]

Due its specificity, the discipline The pollution of the environmental factors creates possibilities of capitalizing for different methods of teaching-learning-evaluation. Each unit has tangencies with the activity of the environment protection specialists, aspect which facilitates the use of the methods based on research, discovery, problematization, accomplished by theoretical or experimental study [6].

Studying various problems related to the environment chemistry, the pollution of air, water, soil and, implicitly the depollution technics which can be applied, problems related to aquatic and terrestrial biodiversity affected by the anthropic pollution, natural risks and by the climatic changes due to the anthropic and natural phenomena, at macrosystem level the students must draw conclusions regarding the essence of the phenomena, processes, structure of the pollutants at the molecular level, namely to the microsystems. In these situations can be applied methods based on analogies and modellings.

The due activities to the laboratory hours have applied charac the discipline ter, related to the environment and life experience of the students and have as finality the training of the competencies specific to the discipline The pollution of the environmental factors. Within the context of the practice of
the laboratory works, the didactic strategies by modelling and by simulation of the problem-situations assures the creation, the training, the improvement of the adequate thinking and action models. This approach of the training contents essentially transforms the don-student relationship and aims the actional markers, the role of everyone in the training process, the specific of the actions and the evaluation stage, underlying the idea that between the don competence and the student competence there is a mutual dependence. The student competences will include cognitive components, operational-technical, motivational, ethical, social and behavioral, specific to every student, the psychological aspect of the educational intercessions having a very important role.

The curricular reform of the environment engineering domain is in flux, dictated by the modern world problems, which tries to find answers to the new challenges. The updated curriculum presents changes at the structure level, as well as at the paradigm level, because at the education base are the pedagogical ends (ideal, goal, objectives), which represent the unity of the psychological requirements of the student (in terms of competences) and of the society requirements (social validated contents) [7].

The updated curriculum of the discipline The pollution of the environmental factors, the speciality books, the treaties of the pollution and depollution of the environment, the practical work manuals and the problem books, concur at the development of the student personality, because of the following functions of:

- transmission of knowledges – by consecutive, logic and systematic exposure of the informations, which helps at forming and at the development of the competences
- forming and development of the competences – by development of the memory, of the cognitive capacities and of repetitive skills
- strengthening of the knowledges and of skills – by updating of the reference knowledges in every learning unit and by means of the problem system with the developmental character; special skills are strengthened by using the installations, apparatus and the laboratory equipments, the glassware and the chemical reactives
- evaluation of the knowledges - by means of the laboratory coloquia, practical evaluations during the semester, written or oral examination during the exams, which allow in the same time the repetition, the development and the selfcontrol [8]
- knowledges integration – on vertical (takes place the liaison knowledges-skills-capacities, the notion system developing on corkscrew) and horizontal (takes place by combining the capacities, obtained in the process of studying at other disciplines, for example, by integration of the organic chemistry knowledges, analitical chemistry, methods and apparatus of measure and control of the environment, biochemistry, ecology)
- educational, cultural and social – the student gains the necessary knowledges in the daily life and for the health of the human body
- reference – by the system of new notions and terms and by throwing light on different interesting facts
- entrepeneurial – by capacity of orientating in the profesional domains of economy and social life and by using the elaboration rules of some research projects.

To approach a method of teaching-learning-evaluation and implicitly of an applied didactic strategy it must be taken into account of the interaction of the four basic components:

1. the don personality: his pedagogical competence, the operation level with the necessary set of knowledges, skills and aptitudes, the possession of some moral qualities, the personal teaching style, character peculiarities
2. the student personality: personalitatea studentului: the capacity and the desire to participate actively in the training process, the understanding of the
necessity to obtain the superior studies, the learning style, the character peculiarities, the internal motivation level, the desire to go to the studies of master or of doctorate in the environment engineering domain, the awaring of the continous

3. the training content: institutionalized by standards and curriculum

4. the training process: the organisation, the use of the technologies, methods and of adequate techniques, which should concur at the productivity of the interactions don-student, student – don, student-student and of all subjects of the training process.

To acquire the specific competences of this actual and controversial domain of knowledge and of environment protection, there are not unique recipes, actual methodical references which should regulate this process, but all depends of the mastery and of the didactic talent of the don, to ensure the forming, training and the development of the knowledges, capacities and aptitudes, by related to the multiple situations of practical application, with the awaring and the exploitation of each case in part, namely reflection.

3. CRITERIA FOR ELABORATION OF A DIDACTIC STRATEGY FOR THE DISCIPLINE „THE POLLUTION OF THE ENVIRONMENTAL FACTORS“

In the process of elaboration and of adoption of a didactic strategy for the discipline The pollution of the environmental factors, it must take into account of the following criteria [9):

- **Didactic criteria** (the correlation with the competences, subcompetences and with the purposes of the theme)

**Examples:**
- the competence of communication in the language specific to the environment engineering domain
- the competence of the experimental investigation the quality indicators of the air, water and soil (practical work, laboratory experiment)
- the selection of the most rational techniques and methods, means of training, stimulation and control related to the content nature (it applies the deductive, inductive or analogical approach)
- the coordination of the methods, training different forms of organisation (frontal, collectively, pairs or individual)
- the diversification of the methods and techniques, to avoid the tiredness, the monotony and the boredom

- **Psychological criteria** (the compliance of the students peculiarities, their types of intelligence and learning styles (visual, auditory, practical), the correspondance of the developmental training principle, activities of conscious knowledge based on activities with practical aspect, applicative, of research and investigation, activities of thinking and imagination, the delegation of the functions and responsibilities of the don to the students, the connection at the specific of the training level) [10]

**Examples:**
- in the second year of studies, in the teaching of the specialized disciplines, the didactic strategies must to concur to reduce to a common denominator of the students which were trained in different high schools and colleges and to form an overview on the
environment pollution (algorithmic methods)
- in the third year of studies, the specific of the parallel content of the speciality disciplines, allows their approach preponderantly by comparing and deducing
- the peculiarity of the fourth year of studies predisposes to use the strategies based on analysis and synthesis (the debate, the elaboration of the semester projects and of the bachelor’s degree work)

- **Criteria related to the organisation technique of the course or of the laboratory** (the theme must be compelling and interesting, with permanent motivational accent. The impulse of catching attention can be carried out by a contextual problem from which derive the subcompetences and the theme purposes.)

Examples:
- to keep the collective attention can be introduced curiosities like „you know...” comparasions with aspects from real life and bearing in mind that the evolving tempo of the activities, the voice modullation of the don and the visual contact are important elements in the application of the didactic strategy.
- the address forms can have a different character:
  - Personalized: What would happen if the air temperature will increase?
  - Hypothesis: How do you think that the industrial activities influence the soil quality?
  - Consulting: What is your opinion related to the produced effects by the eutrophisation of the Jiu river?

To ensure that the applied didactic strategy will have succes on the acquiring of the competences, the don must leave the traditional teaching which lead to the passivity phenomenon, to show attitude, to get involved inward in the act of teaching and of evaluation, to be a behavioral model and to create an active and pleasant environment.

5. CONCLUSIONS
1. The didactic strategy applied in the process of teaching-learning-evaluation of the discipline The pollution of the environmental factors is a coherent and complex system of means, methods and other educational resources which aims the achieving of some purposes.
2. For the discipline The pollution of environmental factors can be elaborated and designed inductive, deductive, analogical, mixed, algorithmical and heuristic didactic strategies.
3. The weighting of the informational, psychological and cybernetics components into a didactic strategy is a measure subordinated to the society-student relationship and must be congruent with the work market requirements.
4. The content units of the discipline The pollution of the environmental factors have tangent with the activity of the specialists in the environment protection domain, aspect which facilitates the use of the methods based on research, discovery, problematization, accomplished by experimental or theretical study, as well of the methods based on analogies, modellings and simulations of the problem-situations.
5. The curricular reform of the environment engineering domain is in flux, dictated by the modern world problems, which try to find answers to the new challenges, and the modern
curriculum presents changes at the structure level, as well at the paradigm level, because at the education base underlie the pedagogical ends, which represent the unity of the psychological requirements of the student, but the society requirements, too.

6. Approaching a teaching-learning-evaluation method it must bear in mind of the interactions of four basic components: the don personality, the student personality, the training content, the training process.

7. During the process of elaboration and adoption of a didactic strategy for the discipline The pollution of the environmental factors must have in mind on the psychological and didactic criteria and of those related to the organisation technique of the class and laboratory.

8. To acquire competences specific to this controversial and actual domain of knowledge and of environment protection, there are not unique recipes or actual methodical recommendations which can regulate this process, but all depend of the procedure with which the don elaborate or apply a didactic strategy, of the mastery, pedagogical talent, of his attitude and inward involvement, that at the end of the educational act, this will be a professional and behavioral model.

Reference


APPLICATIONS TO PROGRAMS INFORMATICS ANSYS-CATIA FOR THE PISTON GROUPS AND THE PROCESSING BY ELECTRICAL EROSION. Part 1.

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Abstract: When talking about an engine can not say that a certain song is the most important and least important. Each piece has its role without which the operation of the engine would be impossible or would not meet performance requirements. However piston of an internal combustion engine has a special place because of the role that it has complex demands due to which it is subjected. For an internal combustion engine, the piston is the "Achilles heel" because engine power is limited by the thermal resistance and mechanical piston.

Keywords: piston, piston resistance, thermal and mechanical stresses, internal combustion, electric erosion machines, electrical erosion.

When talking about an engine can not say that a certain song is the most important and least important. Each piece has its role without which the operation of the engine would be impossible or would not meet performance requirements. However piston of an internal combustion engine has a special place because of the role that it has complex demands due to which it is subjected. For an internal combustion engine, the piston is the "Achilles heel" because engine power is limited by the thermal resistance and mechanical piston.

1. Carried out inside the cylinder volume change.
2. Evolution cylinder engine provides fluid (gas inlet and outlet).
3. Guiding the movement of the connecting rod at the same time transmitting the pressure forces the gas.
4. Ensure the tightness of the cylinder, preventing gas leakage and penetration of excess oil.
5. Contribute to the dissipation of heat arising during combustion.

1. INTRODUCTION.

The piston is a mechanical organ in reciprocating translation, which together with parts that accompany it (rings and pin), performs the following functions:
2. THE MACHINES
PROCESSING ELECTRICAL EROSION

Figure 1: The piston diesel engine.

Figure 2: Electrical erosion processing machine ZNC – 30.

2.1. EXPERT SYSTEMS USED TO PROCESS THE PISTONS

Figure 3: The machine to machine interface.
2.2. FEATURES.

2. The EDM parameter can be changed according to the Auto program setting.
3. Automatic 14-step fine machining in single pass.
4. Equipped with high precision Heidenhain 1μm linear encoder.
5. Chinese/ English; Metric/ Inch unit can be displayed on screen.
6. 60 sets working coordinate setting.
8. Be able to machining large area with stable and slow retracting of residue.
9. High precision ball screw for delicate transmission.
10. Be able to machining deep hole with retracting of residue efficiently.
11. Unify operation screen interface is easy to be understood.
12. Be able to indicate electrode wearing, surface toughness, sparking gap of electrode.
13. 0.5A circuit system for finest finish.
14. Multiple fire-proof detection system.
15. Double erect type filtration system separates carbon residue more efficiently.
2.3. SPECIFICATIONS

Table 1.

<table>
<thead>
<tr>
<th>SPECIFICATIONS</th>
<th>ZNC - 30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work Tank Dimensions</td>
<td>885 x 435 x 270 mm</td>
</tr>
<tr>
<td>Work Table Dimensions</td>
<td>470 x 280 mm</td>
</tr>
<tr>
<td>XYZ Axis Travel</td>
<td>250 x 200 x 200 mm</td>
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<tr>
<td>Distance from Main Axis to Table</td>
<td>405 mm</td>
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<tr>
<td>Auxiliary Travel of Z Axis</td>
<td>170 mm</td>
</tr>
<tr>
<td>Max. Workpiece Weight</td>
<td>300 kg</td>
</tr>
<tr>
<td>Max. Electrode Weight</td>
<td>30 kg</td>
</tr>
<tr>
<td>Max. Capacity of Dielectric</td>
<td>200 liters</td>
</tr>
<tr>
<td>Max. Machining Speed</td>
<td>230 mm³ / min</td>
</tr>
<tr>
<td>Min. Wear Rate</td>
<td>&lt; 0.1 %</td>
</tr>
<tr>
<td>Best Surface Finish</td>
<td>&lt; Ra 0.18 μm</td>
</tr>
<tr>
<td>Max. Output Current</td>
<td>30 A</td>
</tr>
<tr>
<td>Input Power</td>
<td>2.4 kVA</td>
</tr>
<tr>
<td>Machine Dimensions L x W x H</td>
<td>130 x 125 x 212 cm</td>
</tr>
<tr>
<td>Total Weight of Machine</td>
<td>1,110 kg</td>
</tr>
</tbody>
</table>

2.4. MACHINE LAYOUT

Figure 5: Electrical erosion machine dimensions.

Figure 6: Electrical erosion machine dimensions.
3. THE GROUP THE PISTON

3.1. PARTS OF A THE PISTON ARE.

1. Piston head.
2. Port region segments.

The head of the piston is required in terms of the heat as it comes into contact with the flue gases and at the same time take up the forces of pressure. Depending on the type of internal combustion engine (petrol or diesel) piston head has different forms: flat, curved or contain a portion of the combustion chamber.

The region contains three channels port-rings are mounted rings. The first segment nearest the piston head, is called a segment compression / heat, the second is called seal segment and the third segment of the lubricant / scraper. The connection the connecting rod piston is effected by means of the bolt mounted in the shoulders of the piston pin recesses also called.

3.2. CONSTRUCTIVE PARTICULARITIES OF THE PISTONS.

Figure 7: Conicity The piston (shown exaggerated).

So that the piston can move in the cylinder, between the piston and the cylinder must be a game. This game is higher when the engine is cold and decreases as the temperature increases.

Figure 8: The thermal deformation of the piston (drawing exaggerated).
Thermal expansion of the piston is not uniform, it is higher in the piston head due to the larger amount of material. Even temperature distribution in the piston body is not uniform, being higher in the head and lower the bottom, in the shell. Because of this form must be slightly tapered piston so that the expansion becomes cylindrical.

Due to the pressing force of the piston pin and thermal expansion slots, the piston is deformed mantle, taking the form of an ellipse with major axis disposed bolt axis. If the major axis of the ellipse is larger than the cylinder bore, there is a danger of jamming / locking of the piston in the cylinder. For this reason, the jacket of the piston is not continuous but is cut away in the areas below the pin axis.

Engine thermal management is particularly complex. In addition to the main engine cooling circuit are provided for the cooling circuits: turbocharger, alternator, EGR and fuel. EGR cooling circuits and fuel system are circuits for low temperature coolant radiator was taken immediately after main engine. The electronic engine control two computers using injection interconnected in master-slave. It allows independent control of each bank injection 6 cylinders.
Figure 12: The injector piston the motor TDI 6.0 litri, V12, 500 CP.

The injectors are provided with flow openings 8 in order to improve the spraying of the fuel into the combustion chamber. The injection is divided injections are performed according to engine operating conditions. For a more efficient cooling of the piston, it is provided with radial channels through which the engine oil. The aftertreatment of exhaust is also divided into two circuits. Thus, each bank exhaust manifold 6 cylinder contains one oxidation catalyst and a particulate filter.

4. APPLICATIONS
PROGRAMS OF INFORMATICS ANSYS FOR PROCESSING EROSION ELECTRICAL TO PISTON.

4.1. APPLICATIONS
PROGRAMS OF INFORMATICS ANSYS FOR PROCESSING EROSION ELECTRICAL TO PISTON.

Figure 13: Finite Element Analysis

Figure 14: The graphics of the piston with programs informatics ANSYS.

Figure 15: The graphics of the piston with programs informatics ANSYS.
Figure 16: The graphics of the piston with programs informatics ANSYS.

Figure 17: The graphics of the piston with programs informatics ANSYS.

Figure 18: The graphics of the piston with programs informatics ANSYS.

Figure 19: The graphics of the piston with programs informatics ANSYS.

Figure 20: The graphics of the piston with programs informatics ANSYS.

Figure 21: The graphics of the piston with programs informatics ANSYS.
4.2. APPLICATIONS

PROGRAMS OF INFORMATICS CATIA FOR PROCESSING EROSION ELECTRICAL TO PISTON.
Figure 28: The programs informatics for the model piston CATIA.

Figure 29: The programs informatics for the model piston CATIA.

Figure 30: The programs informatics for the model piston CATIA.

Figure 31: The programs informatics for the model piston CATIA.

Figure 32: The programs informatics for the model piston CATIA.

Figure 33: The programs informatics for the model piston CATIA.
Figure 34: The programs informatics for the model piston CATIA.

Figure 35: The programs informatics for the model piston CATIA.

5. THE EXPERIMENTAL RESULTS PROCESSING ELECTRICAL EROSION.

Figure 36: The table electrical erosion parameter values.

Figure 37: Different shapes of graphical parameters electrical erosion.

Figure 38: Different shapes of graphical parameters electrical erosion.

Figure 39: Different shapes of graphical parameters electrical erosion.
Figure 40: Different shapes of graphical parameters electrical erosion.

Figure 41: The shape 3D graphics parameters electrical erosion.

Figure 42: The shape 3D graphics parameters electrical erosion.

Figure 43: The shape 3D graphics parameters electrical erosion.

Figure 44: The shape 2D graphics parameters electrical erosion.

Figure 45: The shape 2D graphics parameters electrical erosion.

Figure 46: The shape 2D graphics parameters electrical erosion.

Figure 47: The shape 2D graphics parameters electrical erosion.
Figure 48: The shape 2D graphics parameters electrical erosion.

Figure 49: The shape 2D graphics parameters electrical erosion.

Figure 50: The shape 2D graphics parameters electrical erosion.

Figure 51: The shape 2D graphics parameters electrical erosion.

L180=4

Figure 52: The connection between electrical erosion parameters.

Figure 53: The values of parameters electric erosion in a graphic form 2D.

Figure 54: The table electrical erosion parameter values.

Figure 55: The values of parameters electric erosion in a graphic form 2D.
Figure 56: The table electrical erosion parameter values.

Figure 57: The connection between electrical erosion parameters.

Figure 58: The values of parameters electric erosion in a graphic form 2D.

Figure 59: The shape 2D graphics parameters electrical erosion.

Figure 60: The table electrical erosion parameter values.

Figure 61: The shape 2D graphics parameters electrical erosion.

Figure 62: The connection between electrical erosion parameters.

Figure 63: The shape 2D graphics parameters electrical erosion.
6. CONCLUSIONS

Upon examination with the naked eye seems cylinder piston shape, but it is perfectly true. The pistons are made of metallic materials: aluminum, steel and iron in some cases. Since these materials have thermal coefficient of expansion, it is clear that the dimensions of the piston are not fixed but variable depending on the temperature.

References


APPLICATIONS TO PROGRAMS INFORMATICS ANSYS-CATIA FOR THE PISTON GROUPS AND THE PROCESSING BY ELECTRICAL EROSION. Part 2.

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²Technical University of Cluj-Napoca, ROMANIA, e-mail: badiu.ioan07@yahoo.com

Abstract: A piston machine body, which has a reciprocating motion in a cylinder and which is designed to close a space of variable volume of the cylinder, filled with air or a fuel mixture under pressure fluid. The piston is used for converting internal energy into mechanical work on cars engines, or vice versa, generating machines. In the first case the piston is driven by the internal energy, and in the second he acts on air or fluid (compressor, hydraulic motor).

Several producers of oil engines use injectors for each the piston in part to facilitate their cooling. The injectors are mounted on the engine block and the oil injected into an opening located in the piston head.

Keywords: pistons, engine oil injectors, cooling, heat accumulated, circular holes, EDM.

1. INTRODUCTION

Usually the piston is coupled to a crank mechanism, which converts the rectilinear motion in a circular motion (the engine) and vice versa (on pump). The piston is used as a constructive element in the implementation of piston pumps, which is similar in principle of operation with the compressor. The pistons are made mostly of cast iron or metal alloy lightweight, heat-stable properties. On machines that heat distribution is through the windows, the piston has the function to open or close them. Several producers of oil engines use injectors for each the piston in part to facilitate their cooling. The injectors are mounted on the engine block and the oil injected into an opening located in the piston head.

Figure 1: The oil Injector the piston

Oil injected into the piston head is discharged through circular holes thus eliminating heat in the piston.
2. THE MACHINES PROCESSING ELECTRICAL EROSION

Figure 2: Electrical erosion processing machine ZNC – 50.

2.1. EXPERT SYSTEMS USED TO PROCESS THE PISTONS

Figure 3: The machine processed interface electrical erosion.

2.2. FEATURES

2. The EDM parameter can be changed according to the Auto program setting.
3. Automatic 14-step fine machining in single pass.
4. Equipped with high precision Heidenhain 1μm linear encoder.
5. Chinese/ English; Metric/ Inch unit can be displayed on screen.
6. 60 sets working coordinate setting.
8. Be able to machining large area with stable and slow retracting of residue.
9. High precision ball screw for delicate transmission.
10. Be able to machining deep hole with retracting of residue efficiently.
11. Unify operation screen interface is easy to be understood.
12. Be able to indicate electrode wearing, surface toughness, sparking gap of electrode.
13.0.5A circuit system for finest finish.
14. Multiple fire-proof detection system.
15. Double erect type filtration system separates carbon residue more efficiently.

2.3. SPECIFICATIONS.

<table>
<thead>
<tr>
<th>SPECIFICATIONS</th>
<th>ZNC - 50</th>
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</thead>
<tbody>
<tr>
<td>Work Tank Dimensions</td>
<td>940 x 530 x 350 mm</td>
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<tr>
<td>Work Table Dimensions</td>
<td>630 x 360 mm</td>
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<td>XYZ Axis Travel</td>
<td>350 x 250 x 200 mm</td>
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<td>Distance from Main Axis to Table</td>
<td>520 mm</td>
</tr>
<tr>
<td>Auxiliary Travel of Z Axis</td>
<td>200 mm</td>
</tr>
<tr>
<td>Max. Workpiece Weight</td>
<td>500 kg</td>
</tr>
<tr>
<td>Max. Electrode Weight</td>
<td>50 kg</td>
</tr>
<tr>
<td>Max. Capacity of Dielectric</td>
<td>300 liters</td>
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<tr>
<td>Max. Machining Speed</td>
<td>420 mm$^3$/min</td>
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<tr>
<td>Min. Wear Rate</td>
<td>&lt; 0.1 %</td>
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<tr>
<td>Best Surface Finish</td>
<td>&lt; Ra 0.18 μm</td>
</tr>
<tr>
<td>Max. Output Current</td>
<td>50 A</td>
</tr>
<tr>
<td>Input Power</td>
<td>3.3 kVA</td>
</tr>
<tr>
<td>Machine Dimensions L x W x H</td>
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</tr>
<tr>
<td>Total Weight of Machine</td>
<td>1,375 kg</td>
</tr>
</tbody>
</table>

2.4. MACHINE LAYOUT.

Figure 5: Electrical erosion machine dimensions.

Figure 6: Electrical erosion machine dimensions.

3. THE GROUP THE PISTON

For a better understanding of the distribution of temperatures on the body of a the piston in an engine design phase, graphic stations is done using finite element analysis. Piston,
three-dimensional model is undergoing a heat source, resulting the temperatures distribution:

Figure 7: The temperatures distribution in the body of the piston.

1. 267 °C
2. 235 °C
3. 226 °C
4. 218 °C
5. 191 °C

In conclusion to limit the thermal load of a the piston engine should operate at low engine speeds and loads more.

3.1. ADVANCED TECHNOLOGIES FOR APPLIED TO THE PISTONS.


Since 2006 Federal Mogul pistons started marketing Thermoshield, for high power motors. The innovation consists in coating the piston of the head with a ceramic coating to withstand temperatures up to 1093°C with durability compared with conventional pistons.

Figure 8: The piston Thermoshield.

The method consists of a special electroless plating to the surface of the piston converted into a complex ceramic high thermal and mechanical resistance. This technology can be applied and fire channel segment, thus avoiding microsudurile between the piston and segment.

3.1.2. OF STEEL THE PISTONS (Federal Mogul -Monosteel).

In 2006, during a ceremony held on April 3rd in Detroit, Federal Mogul company receives PACE Award for innovation, technological advancement and business performance. This award is given to suppliers in the industry that produce, process or offering automobile manufacturers.

Figure 9: The piston Monosteel.
4. APPLICATIONS PROGRAMS OF INFORMATICS FOR PROCESSING EROSION ELECTRICAL TO PISTON.

4.1. APPLICATIONS PROGRAMS OF INFORMATICS ANSYS FOR PROCESSING EROSION ELECTRICAL TO PISTON.

Figure 10: The graphics of the piston with programs informatics ANSYS.

Figure 11: The graphics of the piston with programs informatics ANSYS.

Figure 12: The graphics of the piston with programs informatics ANSYS.

Figure 13: The graphics of the piston with programs informatics ANSYS.

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4.2. APPLICATIONS PROGRAMS OF INFORMATICS CATIA FOR PROCESSING EROSION ELECTRICAL TO PISTON.

Figure 20: The programs informatics for the model piston CATIA.
Figure 21: The programs informatics for the model piston CATIA.

Figure 22: The programs informatics for the model piston CATIA.

Figure 23: The programs informatics for the model piston CATIA.

Figure 24: The programs informatics for the model piston CATIA.

Figure 25: The programs informatics for the model piston CATIA.

Figure 26: The programs informatics for the model piston CATIA.
5. THE EXPERIMENTAL RESULTS PROCESSING ELECTRICAL EROSION

Figure 27: The table electrical erosion parameter values.

Figure 28: The shape 3D graphics parameters electrical erosion.

Figure 29: The values of parameters electric erosion in a graphic form 3D.

Figure 30: The table electrical erosion parameter values.

Figure 31: The shape 2D graphics parameters electrical erosion.

Figure 32: The table electrical erosion parameter values.

Figure 33: The shape 3D graphics parameters electrical erosion.

Figure 34: The values of parameters electric erosion in a graphic form 3D.
Figure 35: The table electrical erosion parameter values.

Figure 36: The values of parameters electric erosion in a graphic form 2D.

Figure 37: The table electrical erosion parameter values.

Figure 38: The values of parameters electric erosion in a graphic form 3D.

Figure 39: The table electrical erosion parameter values.

Figure 40: Points that determines the parameters The electrical erosion.

Figure 41: Straight lines The electrical parameters and equations erosion 2D shapes.

Figure 42: The straight lines and The electrical erosion parameters such equations.
6. CONCLUSIONS

The product category piston Monosteel has won. Innovative technologies underlying the piston Monosteel contribute to improved performance of heat resistance, mechanical, abrasive and corrosive, this the piston is used in road transport diesel applications. Federal Mogul engineers developed a friction welding technology, which gave birth to a light steel piston called Monosteel. In addition to increased mechanical strength piston also benefits from oil cooler massive galleries that allow higher thermal regimes.

References
[52] Kovalevskyy, S.V.; Tulupov, V.I.; Dašić, V.P. and Nikolaenko, A.P.: The research of electro-impulse turning process.


APPLICATIONS TO PROGRAMS INFORMATICS ANSYS-CATIA FOR THE PISTON GROUPS AND THE PROCESSING BY ELECTRICAL EROSION. Part 3

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2Technical University of Cluj-Napoca, ROMANIA, e-mail: badius.ioan07@yaho.com

Abstract: A solution adopted by car manufacturers to reduce CO\textsubscript{2} emissions and improve fuel consumption is to increase of the motor power liters. In other words it is desired that the engine displacements increasingly less power to achieve increasingly higher (engine downsizing).

Keywords: aluminum piston, thermal resistance, increase resistance to fatigue, the coefficient of thermal expansion, EDM, materials, electrical erosion.

1. INTRODUCTION

Piston parts are: head, which is to take the pressure to shape the work room (the engine combustion chamber or space harmful to piston compressors), and in some pistons (the injection process Meurer from diesel engines) and to vaporize the fuel can be: flat, concave, convex, convex shaped, concave shaped. Head shape depend on the compression ratio, combustion chamber shape, valve position. One of the forms of the head of the piston is; head deflector. Skirt or jacket, which serves to guide the piston in the cylinder piston rods not guided by the head of the cross. Shoulders that are some bosses that allow a sufficient contact surface between the piston and bolt, the pistons rods not transmit force by the cross-head, bolt hole is offset (0,5-1,5mm) left cylinder axis opposite direction of rotation of the engine torque reduction tipping the piston and the cylinder reducing its beat. The channels for the segments, which serve as support and guide for the rings (which provides sealing of the cylinder). Some pistons have the first segment in channel compression, built round a ring of steel as the material of the right channel loses its hardness easier. In May, the channel segment has holes for draining lubricating oil scraped off the rolls. To meet the specific powers growth engines, especially by overeating, Federal Mogul has developed an aluminum the piston possessing outstanding thermal and mechanical resistance. Named DuraBowl piston has a local quenching head technology, which leads to increased fatigue strength in areas where stresses are intense.
2. THE MACHINES PROCESSING ELECTRICAL EROSION

2.1. EXPERT SYSTEMS USED TO PROCESS THE PISTONS

Figure 1: The piston DuraBowl.

2.2. FEATURES

2. The EDM parameter can be changed according to the Auto program setting.
3. Automatic 14-step fine machining in single pass.
4. Equipped with high precision Heidenhain 1μm linear encoder.
5. Chinese/ English; Metric/ Inch unit can be displayed on screen.
6. 60 sets working coordinate setting.

Figure 2: Electrical erosion processing EDM machine S500 CMAX

Figure 3: The machine processed interface electrical erosion.

Figure 4: The use of expert systems.
8. Be able to machining large area with stable and slow retracting of residue.
9. High precision ball screw for delicate transmission.
10. Be able to machining deep hole with retracting of residue efficiently.
11. Unify operation screen interface is easy to be understood.
12. Be able to indicate electrode wearing, surface toughness, sparking gap of electrode.
13. 0.5A circuit system for finest finish.
14. Multiple fire-proof detection system.
15. Double erect type filtration system separates carbon residue more efficiently.

2.3. SPECIFICATIONS.

Table 1.

<table>
<thead>
<tr>
<th>SPECIFICATIONS</th>
<th>ZNC - 90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work Tank Dimensions</td>
<td>1240 x 700 x 435 mm</td>
</tr>
<tr>
<td>Work Table Dimensions</td>
<td>800 x 450 mm</td>
</tr>
<tr>
<td>XYZ Axis Travel</td>
<td>500 x 400 x 350 mm</td>
</tr>
<tr>
<td>Distance from Main Axis to Table</td>
<td>650 mm</td>
</tr>
<tr>
<td>Auxiliary Travel of Z Axis</td>
<td>170mm</td>
</tr>
<tr>
<td>Max. Workpiece Weight</td>
<td>1350 kg</td>
</tr>
<tr>
<td>Max. Electrode Weight</td>
<td>200 kg</td>
</tr>
<tr>
<td>Max. Capacity of Dielectric</td>
<td>600 liters</td>
</tr>
<tr>
<td>Max. Machining Speed</td>
<td>480 mm³ / min</td>
</tr>
<tr>
<td>Min. Wear Rate</td>
<td>&lt; 0.1 %</td>
</tr>
<tr>
<td>Best Surface Finish</td>
<td>&lt; Ra 0.18 μm</td>
</tr>
<tr>
<td>Max. Output Current</td>
<td>60 A</td>
</tr>
<tr>
<td>Input Power</td>
<td>4.06 kVA</td>
</tr>
<tr>
<td>Machine Dimensions L x W x H</td>
<td>205 x 180 x 244 cm</td>
</tr>
<tr>
<td>Total Weight of Machine</td>
<td>2,620 kg</td>
</tr>
</tbody>
</table>
2.4. MACHINE LAYOUT.

![Figure 5: Electrical erosion machine dimensions.](image)

3. THE PISTON GROUP.

Federal Mogul engineers developed a friction welding technology, which gave birth to a light steel piston called Monosteel. In addition to increased mechanical strength piston also benefits from oil cooler massive galleries that allow higher thermal regimes.

3.1. ADVANCED TECHNOLOGIES FOR APPLIED TO THE PISTONS.

3.1.1. THE PISTONS BIMETAL (Mahle – Ferrotherm).

A solution offered by Mahle for increasing heat and pressure regimes of diesel engines, road transport is Ferrotherm piston. It is composed of two parts, detachable, made of different materials. The piston head and the sheath is made of forged steel piston made of aluminum. The two parts that make up the piston, are joined through bolt.

![Figure 7: The piston Ferrotherm.](image)

This design is the answer to the various demands being put on the piston. Thus jacket piston aluminum, serves as a guide and piston head, Of steel, thermal and mechanical take in the combustion chamber. As the Of steel, compared with the all-aluminum piston, the piston head can withstand higher thermal and mechanical.
At the same time the piston is improved durability and life cycle of the first segment is extended. Another advantage of the head of the thermal expansion coefficient of steel is that, compared to aluminum, is lower and allows for smaller games between the piston and the cylinder. To compensate for the lower heat transfer steel piston is provided with generous galleries with oil cooling.

3.1.2. OF STEEL PISTONS (Mahle – Monotherm).

A new generation of pistons restore standard diesel engines, high performance, road transport: pistons Monotherm. Even under extreme operating conditions (200 bar) sustainability of a the motor transport vehicles want to be over one million kilometers. A solution to this requirement is Monotherm, produced entirely from forged steel piston.

Monotherm peculiarity consists in closing piston cooling channel between the head and the port region segments through a metal cover. Lower coefficient of thermal expansion, where steel erection allowed smaller games, which resulted in of the motor quieter operation and lower oil consumption.

3.1.3. THE LOCAL HARDENING THE PISTON HEAD (Federal Mogul – DuraBowl).

Figure 8: The steel Pistons Monotherm.

Figure 9: The piston DuraBowl.

4. APPLICATIONS PROGRAMS OF INFORMATICS FOR PROCESSING EROSION ELECTRICAL TO PISTON.

4.1. APPLICATIONS PROGRAMS OF INFORMATICS ANSYS FOR PROCESSING EROSION ELECTRICAL TO PISTON.
Figure 10: The graphics of the piston with programs informatics ANSYS.

Figure 11: The graphics of the piston with programs informatics ANSYS.

Figure 12: The graphics of the piston with programs informatics ANSYS.

Figure 13: The graphics of the piston with programs informatics ANSYS.

Figure 14: The graphics of the piston with programs informatics ANSYS.

Figure 15: The graphics of the piston with programs informatics ANSYS.
Figure 16: The graphics of the piston with programs informatics ANSYS.

Figure 17: The graphics of the piston with programs informatics ANSYS.

Figure 18: The graphics of the piston with programs informatics ANSYS.

Figure 19: The graphics of the piston with programs informatics ANSYS.

Figure 20: The graphics of the piston with programs informatics ANSYS.
4.2. APPLICATIONS PROGRAMS OF INFORMATICS CATIA FOR PROCESSING EROSION ELECTRICAL TO PISTON.

Figure 21: The programs informatics for the model piston CATIA.

Figure 22: The programs informatics for the model piston CATIA.

Figure 23: The programs informatics for the model piston CATIA.

Figure 24: The programs informatics for the model piston CATIA.

Figure 25: The programs informatics for the model piston CATIA.

Figure 26: The programs informatics for the model piston CATIA.
5. THE EXPERIMENTAL RESULTS PROCESSING ELECTRICAL EROSION

Figure 27: The programs informatics for the model piston CATIA.

Figure 28: The straight lines and the electrical erosion parameters such equations.

Figure 29: The straight lines and the electrical erosion parameters such equations.

Figure 30: The straight lines and the electrical erosion parameters such equations.

Figure 31: The shape 3D graphics parameters electrical erosion.

Figure 32: Different shapes of graphical parameters electrical erosion.

Figure 33: The shape 2D graphics parameters electrical erosion.
6. CONCLUSIONS

Powers Current liters of diesel increased from 50 CP/liter to about 94CP/liter. These performances are obtained because of the extreme physical processes that are at the head of the piston (temperatures up to 400°C and a pressure exceeding 200 bar). Under these conditions the piston head, being the most exposed to stress, was a source of defect. The local hardening of aluminum piston head achieved a better grain silica particles (10% of baseline) leading to increased strength and durability. This unique technology of the local remelting aluminum-silicon alloy, combined with the rapid cooling process, leading to change of the metal
microstructure by reducing the particle size of the silica. The result is a piston with a superficial layer of a few millimeters which possess a high thermal and mechanical resistance.

References
[85] Kovalevskyy, S.V.; Tulupov, V.I.; Dașić, V.P. and Nikolaenko, A.P.: The research of electro-impulse turning


THE TECHNOLOGY INFORMATICS AutoCAD USED TO PROCESS ELECTRICAL EROSION IN ALUMINIUM USED IN AIRPLANES.
Part 1

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Abstract: The plane is an aerodyne equipped with a flat bearing surface ensures sustentation due speed. External shape of the aircraft, dimensions, engine, structural organization of its components directly influences performance. The plane is a complex apparatus normally consists of four subsystems: structure resistance powertrain board equipment and flight control devices, equipment and mechanization aircraft. Travel speed can be achieved either by the action of powertrains or action component weight (for flight or flight descent without engine). Changing direction or velocity of fluid flow generates a force. Specifically, port occurs when fluid flow is "turned" by a solid object. When the flow is deflected in one direction, Gates appears in the opposite direction, in accordance with the principle of action and reaction of Newton. Since air is a fluid, the molecules are free to move and can turn any solid surface flow. For a wing section - called aerodynamic profile - both its surfaces, top - bottom extrados respectively - soffit contribute to the return flow. Taking into account only one of the surfaces, we arrive at a theory incorrect lift, so they are addressed together. When two solid objects interact in a mechanical process, forces are transmitted or applied in a "point of contact". But when a solid body interacts with a fluid, things are more difficult to describe, because the fluid changes its shape. For a solid immersed in a fluid, the focal point is any point on the surface of the solid. So we deal with distributed power, ie pressure.

Keywords: airplane, propulsion systems, electrical erosion, AutoCAD.

1. INTRODUCTION

A body located in a moving fluid, the speed will have different values at different points along the closed surface of the body. Local pressure (given by small forces those areas that I mentioned) is directly related to the local velocity is also clear that it will vary throughout the area closed. Summing all local pressures normal and then multiplying the total outer surface of the body will result in a force. The component of this force perpendicular to the direction of flow of the...
fluid is known as load bearing capacity, and the component along the direction of the flow called drag. In reality there is only one force, caused by pressure variation around the body surface or - speaking airfoil - is caused by the difference between the pressures in the extrados intrados respectively profile. The aerodynamic force acting in a determined point the pressure distribution, a point called the center of pressure.

2. THE MACHINES PROCESSING ELECTRICAL EROSION ALUMINIUM.

Figure 1: Machines for precision wire EDM AW-510

Figure 2: The structure of the material composition: Al, Si 1.2, Mg 0.4

Figure 3: The structure of the material composition: Al, Si 1.2, Mg 0.4.

3. THE STRUCTURE OF ALUMINIUM MATERIAL USED IN THE CONSTRUCTION OF AIRCRAFT.

They are written in the format that is being described. Please follow these instructions.
Figure 4: The structure of the material composition: Al, Fe 0.5, Mn 1.0 / Al, Si 1.0

Figure 5: The structure of the material composition: Al, Fe 0.5, Mn 1.0 / Al, Si 1.0

Figure 6: The structure of the material composition: Al 88, Si 12

Figure 7: The structure of the material composition: Al 88, Si 12

4. THE TECHNOLOGY INFORMATICS AutoCAD USED ON AIRCRAFT.

Figure 8: Function AutoCAD to design airplanes.
Figure 9: Function AutoCAD to design airplanes.

Figure 10: Function AutoCAD to design airplanes.

Figure 11: Function AutoCAD to design airplanes.

Figure 12: Function AutoCAD to design airplanes.

Figure 13: Function AutoCAD to design airplanes.
5. THE EXPERIMENTAL RESULTS PROCESSING ELECTRICAL EROSION.
Figure 19: The electrical erosion parameter values.

Figure 20: The connection between electrical erosion parameters.

Figure 21: The reporting of to the maximum the electrical erosion parameters.

Figure 22: The electrical erosion parameter values.

Figure 23: Table containing the values parameters of electrical erosion.

Figure 24: The connection between electrical erosion parameters.
Figure 25: The reporting of to the maximum the electrical erosion parameters.

Figure 26: The form 3D graphics parameters electrical erosion.

Figure 27: Table containing the values parameters of electrical erosion.

Figure 28: The form 3D graphics parameters electrical erosion.

Figure 29: The shape 2D the electrical erosion parameters.

Figure 30: The shape 2D the electrical erosion parameters and their values.
Figure 31: Table containing the values parameters of electrical erosion.

Figure 32: The shape 2D the electrical erosion parameters and their values.

Figure 33: Table containing the values parameters of electrical erosion.

Figure 34: The reporting of to the maximum the electrical erosion parameters.

Figure 35: Table containing the values parameters of electrical erosion.

Figure 36: The form 3D graphics parameters electrical erosion.
Figure 37: Table containing the values parameters of electrical erosion.

Figure 38: 3D shape the electrical erosion parameters and their values expressed in percent.

Figure 39: 3D shape the electrical erosion parameters and their values expressed in percent.

Figure 40: 3D shape the electrical erosion parameters and their values.

Figure 41: 3D shape the electrical erosion parameters and their values expressed in percent.

Figure 42: 3D shape the electrical erosion parameters and their values expressed in percent.
6. CONCLUSIONS.

Port is a mechanical force generated by the interaction and contact between a solid and a fluid. It is caused by a force field such as weight, which is generated by the gravitational field, where a body can interact on another body without actual physical contact. To lift, a solid body to be in direct
contact with the fluid. Therefore, if there is fluid, there is no motion. On the other hand, the port is generated by the speed difference between solid and fluid body. There must be movement between the object and the fluid. So if there is movement, there can be portable. Whether the fluid is in motion, the body is static or moving body fluid. Factors influencing the gates are the shape and size of the object, the speed and direction of movement to the main fluid, fluid density, compressibility and its viscosity.

References


THE TECHNOLOGY INFORMATICS AutoCAD USED TO PROCESS ELECTRICAL EROSION IN ALUMINIUM USED IN AIRPLANES. Part 2.

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3Faculty of Engineering, University "Constantin Brancusi" of Târgu-Jiu, ROMANIA.
4High Technical Mechanical School of Professional Studies in Trstenik, SERBIA.

Abstract: Between two electrodes - one of which is the tool, and the other consists of the part to be processed - is applied to a pulsed power supply that causes a series of electrical discharges. Downloading the electrode can occur in a vacuum, gas at normal temperature and pressure in the liquid; in EDM equipment for process efficiency, choose a liquid dielectric medium whose conductivity is about \(10^{-10}\) (1/ohm.cm). It provides for the application of pulses which cause thunder and not a constant voltage so that the discharge does not turn into a continuous electric arc, unable master the process of erosion of metal which must be perfectly controlled. The voltage application electrode tool - which in this case plays the role of cathode - you will have a strong emission of electrons in the field established between electrodes, \(10^5\) to \(10^7\) V/cm will be accelerated, will gain kinetic energy and successive collisions will create November secondary electron molecules will dissociate dielectric will create displacements of atoms evaporated metal electrodes. Avalanche that is formed between the two electrodes is characterized by a rich front in positive and negative charges, whose temperature is 8000-12000°C.

Keywords: AutoCAD, technology informatics, aluminum, electrical erosion.

1.INTRODUCTION

Plasma current density reaches values of the order of \(10^4\)-\(10^9\) A/cm², facilitating the creation of ion channel whose range is limited but the inertia of the liquid. Dilation of the channel and forming a bubble, the pressure is very high, underlying explanation on mechanical and thermal effects that are established, the extraction of metal from the workpiece to be machined. When charged particles strike the surface of the part, from the point of impact, the mechanical energy of them will turn almost no loss in heat, as in adiabatic process. It will extract material from
the workpiece when discharge energy will produce a temperature above the melting temperature of the material, allowing the volatilization of. Discharge channel undergoes a rapid expansion, forming a vapor bubble of high pressure that exceeds the channel, pushing the dielectric fluid. The pressure in the bubble, hundreds of atmospheres, resulting in resistance that opposes the expansion fluid. The current interruption downloading will turn off and the gas bubble will undergo an explosive expansion of active cavitation. The molten material will be screened outside the channel machining fluid remaining in the form of particles of 1-1000 μm in suspension to be discharged from the electrodes and retained filtration equipment.

2.PROCESSING MACHINES ELECTRICAL EROSION ALUMINIUM.

Each car is equipped with Novick Die sinker Orbit II Pro technology that ensures greater precision machining and surface quality.

• It reduces the processing time by 50% and 70% electrode wear.
• Improves finish quality by 50%.
• Exceeds traditional restrictions.
• Improves precision products.
• Increase efficiency and productivity.
• Easy to use, smart design.
• Complete shock and vibration tests.
• Orbit at Novick is possible in three axes (xy + z in, xz and yz + y + x).

Figure 1: Machines for precision wire EDM AW-310.

2.1.NOVICK TECHNOLOGY Orbit II Pro.

Figure 2: Electrical erosion processing machine.

Figure 3: The graphics processing machine electrical erosion.
2.2. THE SYSTEM "FUZZY LOGIC".
As the term artificial intelligence, the term "fuzzy logic" is hard to define. The application to the EDM is very exciting, and means that the control unit does not follow strict rules to reach decisions or conclusions but weighs options according to desired results. This approach is recommended in situations where a problem has more than one answer. "Fairness" is determined by the user's priorities, which may vary from case to case. "Fuzzy logic" is a promising development in the field of EDM as encouraging strategic planning while improving automatic operation. For example, processing conditions to obtain a high precision and a quality finish are similar to those needed to achieve a rapid processing. Choosing different results is a strategic decision that involves processing and setting different parameters and choosing the correct parameters is a complex process. Electroerosion is by nature a variable process and management of these variables is the key to effective treatment. Novick control system based on the 32/64 bit processing, workpiece material requires the user details, dimensions and electrode. The user is then asked to indicate speed machining, finishing and accuracy (according to priorities), along with trail work. The unit responds based on function "fuzzy logic" featuring a series of "results" based on the priorities utilized. In this point, the user can analyze options and can "change your mind", may choose an alternative from the list of recommendations. For example, if a finish and extremely high accuracy are indicated as priorities, processing time will be very long. The user can decide if it is too long and can look again to see what alternatives you finish and precision are available at higher speeds. The settings are determined automatically for the final selection.

3. THE STRUCTURE OF ALUMINIUM MATERIAL USED IN THE CONSTRUCTION OF AIRCRAFT.

Figure 5: The structure of the material composition: Al, Mg 1, 0.8 Si, Mn 0.5

Figure 6: The structure of the material composition: Al, Mg 1, 0.8 Si, Mn 0.5
4. THE TECHNOLOGY
COMPUTER AutoCAD USED
ON AIRCRAFT.

Figure 7: The structure of the material composition: Al, Mg 1, 0.8 Si, Mn 0.5

Figure 8: The structure of the material composition: Al, Mg 1, 0.8 Si, Mn 0.5

Figure 9: The structure of the material composition: Al, Mg 2.5

Figure 10: IT program AutoCAD to design airplanes.

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Figure 12: IT program AutoCAD to design airplanes.
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Figure 23: Table containing the values parameters of electrical erosion.

5. THE EXPERIMENTAL RESULTS PROCESSING ELECTRICAL EROSION.

Figure 24: 3D shape The electrical erosion parameters and their values expressed in percent.

Figure 25: The connection between electrical erosion parameters.

Figure 26: The connection between electrical erosion parameters.
Figure 27: The connection between electrical erosion parameters.

Figure 28: The 2D graph The electrical erosion parameters.

Figure 29: The 2D graph the electrical erosion parameters.

Figure 30: Table containing the values parameters of electrical erosion.

Figure 31: The connection between electrical erosion parameters.

Figure 32: The reporting of to the maximum The electrical erosion parameters.

Figure 33: The reporting of to the maximum the electrical erosion parameters.

Figure 34: Table containing the values parameters of electrical erosion.
Figure 35: Table containing the values parameters of electrical erosion.

Figure 36: Table containing the values parameters of electrical erosion.

Figure 37: The erosion parameters that determine the electrical lines.

Figure 38: Form 2D and electrical erosion parametric equations

Figure 39: Graphical and electrical erosion equation parameters.

Figure 40: Graphical and electrical erosion equation parameters.
Figure 41: Graphical and electrical erosion equation parameters.

Figure 42: Graphical and electrical erosion equation parameters.

Figure 43: Graphical and electrical erosion equation parameters.

Figure 44: The form 3D graphics parameters electrical erosion.

Figure 45: The form 3D graphics parameters electrical erosion.

Figure 46: The form 3D graphics parameters electrical erosion.

Figure 47: Graphical form of electrical erosion parameters.

Figure 48: The graphics in the form of balls and lines parameters.
5. CONCLUSIONS

Processing conventional orbital (orbital planetary motion spherical or electrode) is running from point to point along the target shape and electrode movement is not smooth, leading to an unstable processing. Spherical orbital pattern is a feature common to many advanced CNC machines sinkers. Patterns spherical orbital orbital systems are not possible with mechanical or electronic systems with many mounted on the shaft orbit. With our new generation Orbit II Pro technology, processing is done by an electrode which is in continuous motion, chasing the target shape. The result is a more stable processing. New function smoothly guides the movement Orbit II Pro uniform electrode surfaces without bumps. This advanced technology processing, in which the electrode is in constant motion, resulting in a stable finish machining, precision and superior quality.

References


