DEVELOPMENT OF THE TEST METHODS OF THE CONVEYOR BELTS USED IN ENVIRONMENTS ENDANGERED BY EXPLOSION HAZARDS

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Abstract:*Conveyor belts are used for a long period of time in the industry branches where potentially explosive atmospheres could occur.*

Dangerous phenomena which can be in direct connection with the use of conveyor belts are the ones regarding:

- sparks influence over the coating layer and/or resistance internal structure of the stopped conveyor belt;

- propagation of a flame along the length of a conveyor belt that was exposed to a energy source relative high like a fire or due to blockage of a conveyor belt as a result of the driving mechanism still operating, that generate a local heating of the conveyor belt in contact with the driving drum, rollers or any other heating source generated by friction. Determining the safety parameters characteristic of the conveyor belts by employing test methods allows assessment of the safety level as well as certification of their explosion protection quality when used in environments with explosion danger.

Keywords: conveyor belt, potentially explosive atmosphere, static electricity, flame resistance.

Introduction

Belt conveyors have been used for a long time in most of the industrial branches as well as there where the likelihood of explosive atmospheres occurrence exists.

Unlike normal environments, in the ones with potentially explosive atmospheres the fire/explosions hazard occurs, as consequence of various technological processes or accidental leaks.

In order to mitigate explosion risk in these environments with potentially explosive atmospheres, both equipment and its component (conveyor-transportation belt) must be of special construction so as not to generate electric sparks, impact or friction mechanical sparks, static electricity, hot surfaces or any other energy sources that could ignite the atmosphere.

The conveyor belt, as component of the conveyor, non-metallic, made of rubber or polymers with or without insertions, during operation may build up static electricity charges, thus gaining an electrostatic potential. On the other side, due to belt blockage and excessive rubbing between it and conveyor's driving drum, high temperatures can be developed that could lead to igniting the conveyor belt and further to its burning.

All these phenomena, strictly related to conveyor belts operation, show a high influence on the safety level in technological areas where they are operating.

Having in view this aspect, identifying these phenomena is imposed as necessary; likelihood and frequency of occurrence determination as well as determination of those parameters upon which the safety level depends.

New test methods for determination of the safety parameters of conveyor belts

The importance of determining the specific safety parameters of conveyor belts is given especially by the need of establishing the safety level that has to be ensured regardless of application of intended use.

In case of employing conveyor belts in environments endangered by potentially explosive atmospheres, this importance is even greater due to the explosion hazard that may occur at a certain moment.

In order to avoid this risk and to ensure a high safety level, the conveyor belts have to comply with both constructive and safety requirements. The safety requirements indicators addressed are in fact the safety parameters specific to conveyor belts intended for use in environments with explosion hazard.

Within these parameters class, are the following: the electrostatic potential generated by a conveyor belt during operation, electric resistance, resistance to friction on drum, resistance to burning in gallery, flame resistance.

Initially, in order to determine these safety parameters, test methods given in specific national standards and norms had been applied. Later, through Romania joining the European Union and implicitly harmonization with member states legislation, determination of safety parameters is carried out based on the requirements and test conditions given in the new European standards.

Once the new standards adopted, new test methods had been developed and implemented within the testing laboratory, at the same time with carrying out new test stands, modern, endowed with last generation apparatus.

Test method to determine electrostatic potential generated by a running light conveyor belt in operation

The standard providing the test method is SR EN ISO 21178:2007 (SR EN ISO 21179:2007), applicable for conveyor belts with a inner conductive layer. The admittance condition is not to generate electrostatic charges that could generate a surface potential greater than 500 V [4], [5].

In special conditions of use, electrostatic high amount of static charges that generate a surface potential greater than 500 V may be produced through the rubbing between the belt and the conveyed products or by rubbing between the transported products themselves, or by displacement of belt over the rollers or return drum, in this case dangerous products conveyed are the ones in bulk.

The test is carried out on a new conveyor belt, unused and not submitted to test earlier than five days since manufacturing date; it shall show no traces of contamination or surface faults.

The conveyor belt to undergo the test shall have the length of (2500 ± 50) mm and width of (100 ± 1) mm and shall have no ends. During the tests two results are important and have to be taken into consideration, namely the maximum value reached by the surface potential and a value taken as a constant (for example when after 10 minutes the charge accumulated is below 10%) [6].

In order to determine the electrization potential a special test stand is required, through it a test sample (conveyor belt) having the above mentioned sizes is statically charged while rubbing on drums with a velocity of 5 m/s, ensuring a certain tension in the belt and under specific environment conditions.

Temperature and relative humidity in the test room are relevant and they have to be measured and recorded.

In its motion, the belt sample accumulates charges of electrostatic kind as consequence of its friction on the two drums, thus generating an electrostatic field.

In relation to the device used for recording, either electrostatic intensity *E* in volts per meter or, if the measuring device has a direct potential *U* reading, this value in volts can be recorded.

Figure 1 shows the test stand to determine the electrostatic potential generated by a running conveyor belt [1].

Fig. 1 *- Test stand for determination of the electrostatic field generated by a light transporting belt in operation*
Keyword: 1 - electrostatic field measuring/recording device; 2 - return drum; 4 -metallic plate, 600 mm×200 mm; 5 - metallic plate 200 mm×200 mm; 6 - driving drum; 7 - metallic frame; 8 - tensiometric cell and digital indicator; 9 - motor gear.

Test method for determination of flammability at fire simulation (propane burner)

The test consist in determination of conveyor belt characteristics regarding flame resistance.

Method A – Test with a single propane burner on a length of 2 m

The test is carried out on two belt samples, each of 200 mm length and 1200 mm width or on all width if the conveyor belt has a width lesser than 1200mm; the test samples have to be kept away from moisture 24 hours before the test, at a positive room temperature in order to avoid any residual bending [1], [8].

The test samples are placed on a trestle (fig.3) which is placed in a gallery with a cross section area of maximum 6 m^2, and then the propane burner is placed under the trestle (fig. 2). The exposure time on flame is 10 minutes then they are let to self extinguish subsequently the length of undamaged belt has to be measured.

The admittance condition for the conveyor belts in categories 4A, 4B, 5A, 5B and 5C submitted to tests according to method A of SR EN 12881-1:2003 is the undamaged belt length has to be greater than 100 cm on the tested belt [4], [5].

Method C – Flame propagation test at medium scale

The test is carried out on two belt samples, (conveyor belt with 1500 mm length × 230 mm width). The test samples have to be weighed and placed on an estacade located in the flame testing gallery, having of small dimensions, under which, farther a 6 nozzle burner is placed, fed with propane from a propane cylinder. The air velocity is adjusted in the testing gallery at (1,0 ± 0,05) m/s. The gas flow fed by the cylinder is adjusted at 350 l/h, then the burner is lit up and the test begins, for a period of 50 minutes [2], [8].

At the end of the testing, the sample is weighted. The test result is expressed by the length of intact sample, temperature increase and length of consumed belt have to be measured [2], [8].

Fig. 2 *– Burner for test method for determination of flammability of the conveyor belts*

Fig. 3 *- Burner trestle to support the conveyor belt sample*

Test method to determine the resistance to friction drum

The method of test to determine the propensity of a conveyor belt to generate heat flame or glow when held stationary under a given tension, in surface contact around a rotating driven steel drum is given in SR EN 1554 :2002 *Conveyor belts. Drum friction testing.* [7].

In order to determine the resistance to drum friction, a test piece of conveyor belt, suitably mounted and tensioned, is wrapped half way around a rotating steel drum, simulating a stalled belt. The test is continued at specified tensions for a given time period, or until the belt breaks. The presence, or absence, of flame or glow is noted and reported and the maximum temperature of the drive drum is recorded. The test is conducted in still air or/and in moving air.

During the testing, the test piece is examined to observe any flame or glowing and detaching of any incandescent particles either during the test or at the end of it.

The test stand for drum friction testing is shown in figure 4 and it consists in: steel drum; drum temperature recording device comprising an aquisition data board and a portable PC, a tensioning system able to apply incremental tensions, an anemometer and a compressor in order to supply the required air flow [3].

Fig. 4 – *The test stand for drum friction testing*

All the three test stands previously described had been carried out as subject of research projects unrolled in the National Research "NUCLEU" Program, where accreditation of the tests had been in view, in order to extend laboratory's testing capacity and implicitly the conformity assessment ability; since it's a well knows fact that proving products conformity, in this case of conveyor belt, with the European standards ensures the presumption of conformity with the requirements of the related European Directive, which is the ATEX 94/9/EC Directive, since INCD-INSEMEx is conformity assessment Notified Body at Brussels. The test stand according to Method C - medium scale flame propagation test is in its course of being executed at INCD-INSEMEX Petroşani.

Conclusions

The conveyor belts having as intended use environments with potential explosive atmospheres have to comply with the essential safety and health requirements regarding explosion protection and prevention.

Development of the safety parameters specific to conveyor belts, through test methods, allows an assessment of the safety level as well as certification of their explosion protection quality when used in environments with explosion hazards.

The test methods allow ensuring repeatability and reproducibility of tests carried out in various test laboratories, fact having a great importance since it offers a real basis of comparison for the tests carried out in accredited laboratories, at European level, for the purpose of obtaining an accurate assessment with the essential safety and health requirements.

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