ADDITIVE MANUFACTURING THROUGH 3D PRINTING FDM-FUSED DEPOSIT MODELING OF PRESS BUSH

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Abstract: *This paper highlights both theoretically and experimentally the use of 3D printing technology, using Fused Deposition Modeling technology. The part that has been printed is the press bushing for the flushing head of the FA100, FA125, FH150 and FG40 water drilling rigs.*
The proposed work falls within the framework of green technologies, friendly to the environment and within the projects for the realization of industrial parts by additive methods, respectively by 3D printing.
This technology offers many advantages compared to the classic manufacturing technologies of that part both in terms of harmful emissions, high energy consumption and the final price of the part.

Keywords: washing head housing, 3D printing, Fused Deposition Modeling, water drilling installation

1.Introduction

Romania's National Strategy on Climate Change requires the adoption of measures to mitigate the effects of global warming and the prolonged drought caused by global warming, and that is why it has declared water as a strategic national reserve in Romania, and real-time monitoring of strategic reserves of water contained in Romania's underground aquifers.

At the moment, water is a strategic resource in the European Union.

In this context, knowing the disposition of the aquifers on the surface of Romania and at depth, it is proposed, through drilling with the FA100 installation, to create a network of smart wells of the IOT-Internet Of Things type, for monitoring the level of underground water at depth H=80m, connected in real time via Arduino microcontrollers with WiFi transmission to the Internet Router, which will indicate in real time on the Internet page of the water well the depth at which the underground water is located, for the respective area.

Thus, it is proposed to align with the new reindustrialization of the EU by demonstrating the capability of manufacturing the prototype of the FA100 water well drilling installation, at the best price / quality ratio, through 3D printing, now also with high resistance carbon fiber filament.

The FA100 washing head press bushing prototype will be manufactured by 3D printing ABS+ filament on Creality Ender 3 V2 3D printer, Shenzen China [2], [3]. This new version of the realization of the various parts offers many advantages compared to the classical processes of realization.

Figure 1. Drilling rig FA100

2. Fabrication

Figure 2 shows the execution drawing for the pressing bush part for the washing head sub-assembly of the FA 100 drilling rig.

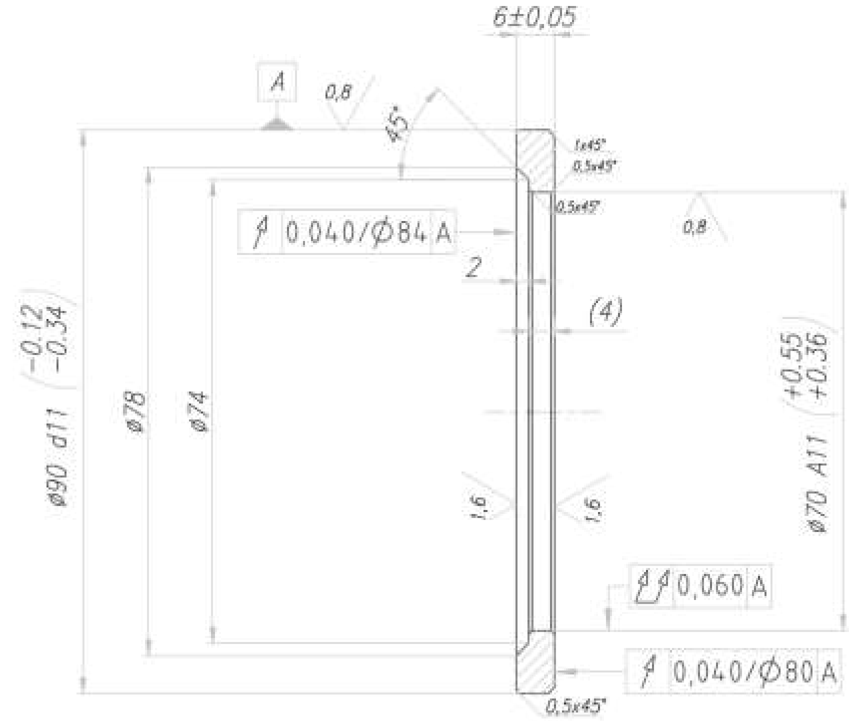

Figure 2. Execution drawing - press bushin

In figure 3 shows the 3D modeling in the Autodesk Fusion 360 program of the "Press Bushing" part, which results in the STL format file for "slicing" before its 3D printing.

Figure 3. *3D modeling in the Autodesk Fusion 360 program of the "Press Bushing" part, resulting in the STL format file for "slicing" before its 3D printing*

Figure 4 shows the 3D slicing modeling of the "Press Bushing" landmark, with the help of the slicing program, Ultimaker Cura 4.13.1

Figures 5 and 6 show the slicing settings of the "Press Bushing" feature.

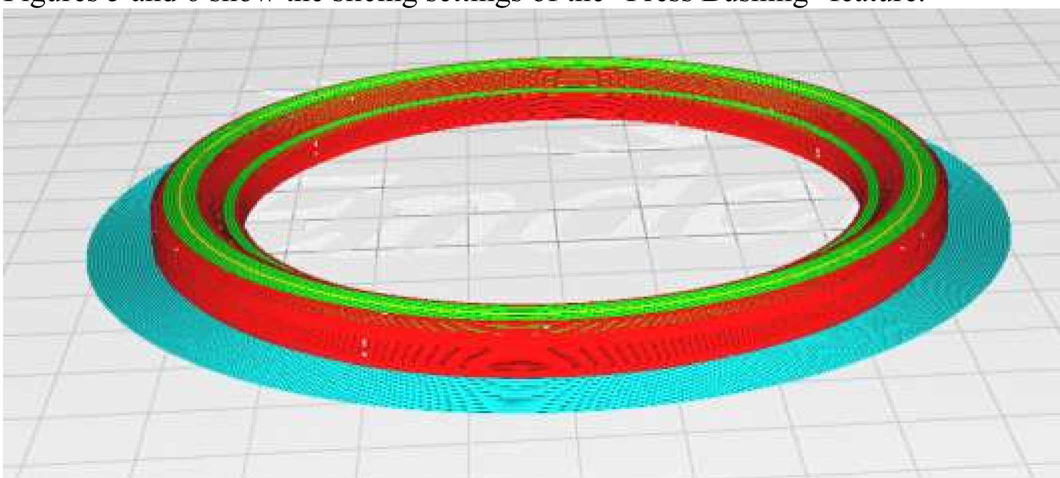

Figure 4. 3D slicing modeling of the "Press Bushing" landmark, using the slicing program, Ultimaker Cura 4.11.

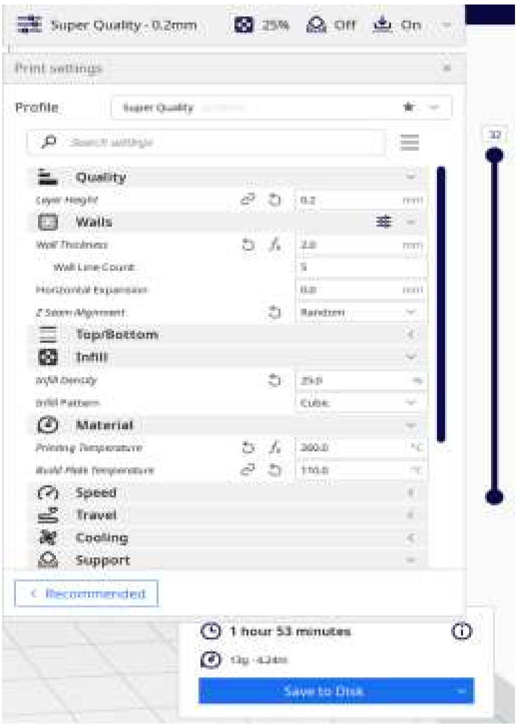

Figure 5. The slicing settings of the "Press Bushing" feature

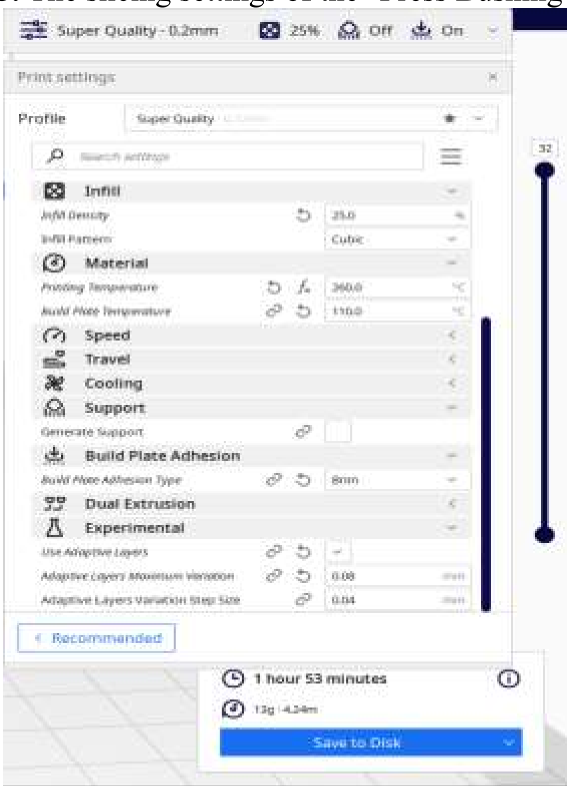

Figure 6. The slicing settings of the "Press Bushing" feature

The main slicing settings for the "Press bushing" feature, in Cura 4.13.1., were as follows:
-Layer height= 0,2 mm;
-Wall thickness= 3 mm;
-Z-Seam Alignment= Random;
-Infill density= 25;
-Infill Pattern= Cubic;
-Material= ABS+
-Printing Temperature= 260ºC;
-Build Plate Temperature= 110ºC;
-Generate Support= Yes;
-Support Structure= Tree;
-Tree Support Branch Angle= 40º;
-Support Placement= Everywhere;
-Support Overhang Angle= 39º;
-Build Plate Adhesion Type= Raft;
-Experimental
-Use Adaptive Layers= Yes;
-Adaptive Layers Maximum Variation= 0,08 mm;
-Adaptive Layers Variation Step Size= 0,04 mm;
- The 3D printing of the "Press Bushing" landmark took 1 hour and 53 minutes. and consumed 13g of ABS+ filament
The Slice command is given.

Figure 7 shows the "Press Bushing" landmark, 3D printed using ABS+ filament on Creality's Ender 3 V2 3D printer.

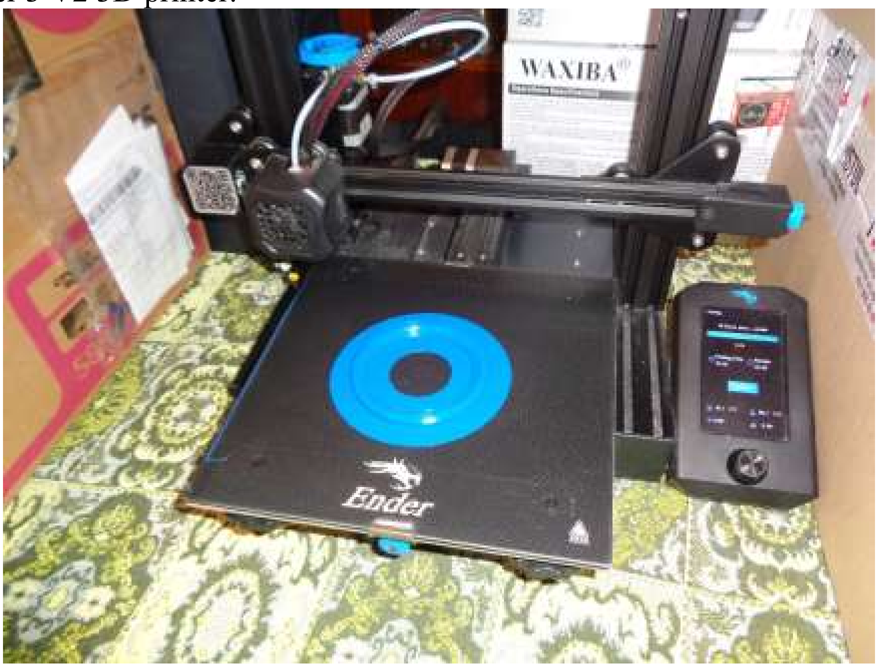

Figure 7. "Press Bushing" landmark, 3D printed using ABS+ filament on Creality 3D printer, Ender 3 V2

3.Experimental results

The experimental samples for the "Press Bushing" benchmark that were executed by 3D printing using ABS+ filament have very good operational behavior. The tests were carried out under similar working conditions to the alloy steel product and the results expressed in hours of operation did not differ between the two parts.

The assembly of 3D printed landmarks in the drilling rig is shown in figure 8.

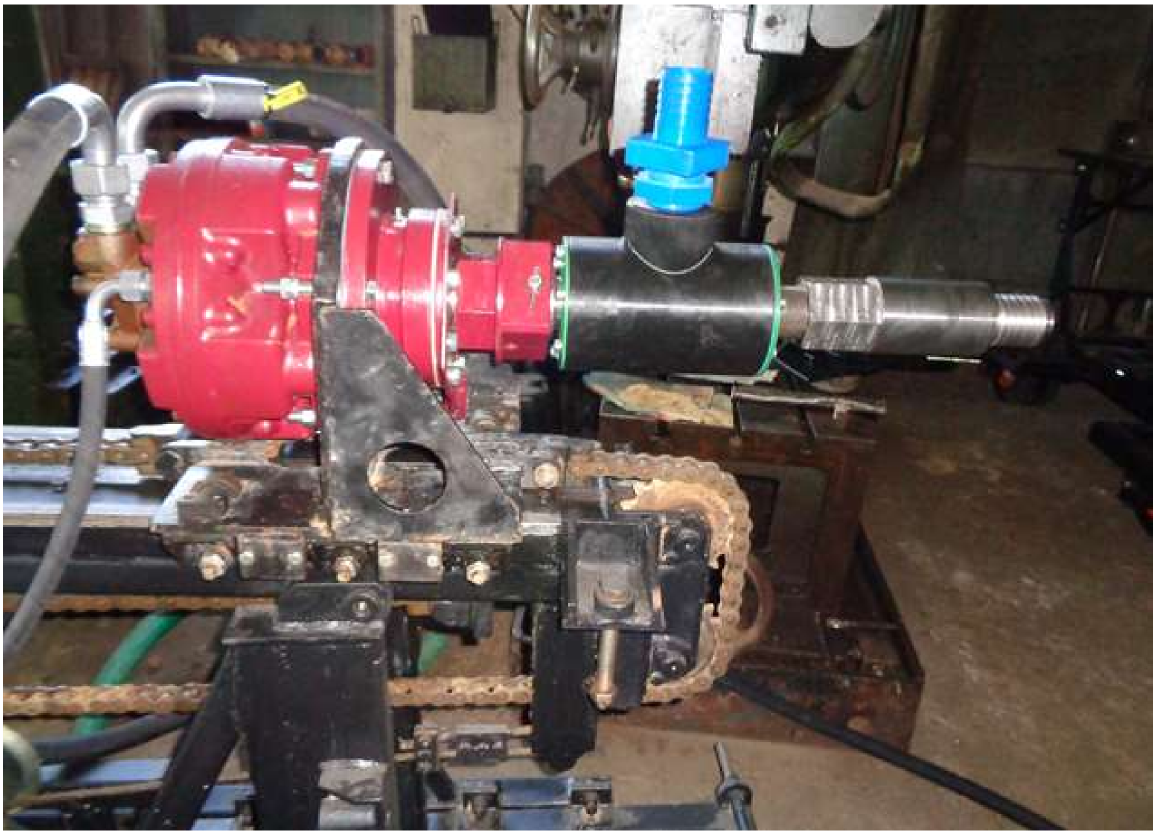

Figure 8Integration of 3D printed landmarks to the FA 125-FG 40 drilling rig

4. Conclusions

In today's market economy and considering directives to reduce energy consumption and lower pollution standards, the manufacture of parts by 3D printing is becoming an objective at an industrial level.

These technologies become feasible due to low energy consumption, very low material losses, high productivity and last but not least from an economic point of view.

From the point of view of energy consumption, a differentiation can be made in the 1/42 ratio between the technology developed in the work and the operations performed by classical turning technologies.

From the point of view of material efficiency, 3D printing technology has no loss compared to turning operations that would use a disc with a diameter of 90 mm and a thickness of 7 mm from which the inside would be removed.

From the point of view of labor productivity, the time of only 1 hour and 53 minutes in the case of 3D printing should be taken into account compared to the time of 3 hours and 21 minutes calculated by turning operations.

The "Press Bushing" part has a cost 8 times lower through 3D printing technology than the part made by classic technologies from classic materials.

From the point of view of the behavior in use from the tests carried out, values similar to the original part resulted.

We can conclude that the prototype is a success and can be used on an industrial scale.

References

[1] Fica Sorin Alexandru, *Realizarea unei instalații inovative de foraj hidrogeologic cu acționare hidraulică a sistemului de manevră si acționare mecanică a capului de foraj de tip FA125,* Programul cercetare NUCLEU, 2017

[2] V.Zukas, Jonas A. Zukas, *An Introduction in 3D Printing*, First Edition Design Publishing Inc., 2015

[3] A.K.France, *Make: 3D Printing, the Essential Guide to 3D Printers*, Maker Media, 2020