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IMPROVEMENT OF SAWING PROCESS WITH HARD METAL BLADES FOR HIGH CHROMIUM TUBES

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Abstract: *This study aims to find alternatives to increase the performance of saws used in cutting materials with high chromium content, so this income is close to the performance found in cutting carbon steel, permitting then cut into pipe line currently production. At first will be analyzed the influence of parameters cutting speed and feed per tooth evaluating the number of cuts made with each saw. Then be made to optimize the cutting parameters, so as to obtain a better surface finish, operating time and the number of cuts reached. Finally, a new test will be performed with PVD coated saw (Physical Vapour Deposition). In general, it was observed that by increasing the cutting speed and feed, a better surface finish was optimized cutting process due to a shorter cutting saw and achieved a higher number of cuts. Finally, with the use of coated saw, beyond getting a better surface finish, the numbers of cuts made by the saw was about 330% greater than in the previous step.*

Keywords: Sawing, cutting parameters, carbide, coating.

1. INTRODUCTION

Since ancient times, man has been using basic tools made of stone to obtain objects of daily use, be they simpler or more complex. One of the main objects obtained through this primitive method were weapons (tips and knives) used in the hunting and the war and since then the machining has been evolving enormously. Further studies in the field of machining began only in the early nineteenth century. High speed steel (HSS) represented the first major milestone in the history of machining, as it allowed the use of higher cutting speeds in the cutting process and, consequently, a significant increase in process productivity. Nowadays, the machining is present in several sectors, such as automotive, naval, aerospace, electronics, among many others.

Sawing with circular saw blades is a widely used machining process, ready to provide information relatively fast, accurate and with good surface finish. Currently one of the most used materials in saw blades and carbide. This material is obtained by pressing and sintering a mixture of tungsten carbon powders and other binder materials such as cobalt and nickel. This material presents a high performance, as it allows the use of advances and cutting speeds in the machining process, when comparing the parameters used with the high speed steel.

In this work, tests on blades used in the cutting of seamless steel tubes were performed. To increase the performance of this tool, it was evaluated the cutting parameters and the use of thin film tribological coating. To increase the performance of this tool, it was evaluated the cutting parameters and the use of a thin film tribological coating.

2. EXPERIMENTAL PROCEDURE

The material of the specimen used was the stainless steel whose composition is 0,02% C, 13% Cr, 5% Ni e 2% Mo. A tube of approximately 5 meters in length was used to perform the tests. The circular saws used have an external diameter of 800 mm and 110 teeth, as shown in figure 1. The inserts used are of hard metal grade P25. The attachment of the saw to the equipment is made by flanges. The cutting fluid used was a KHO 700 emulsion at a concentration of 3%.

Figure 1. Circular saw used in the tests

The tests were performed on an SCMD 760 saw (Franho) as shown in figure 2. After the test, the surface finish of each ring was checked.

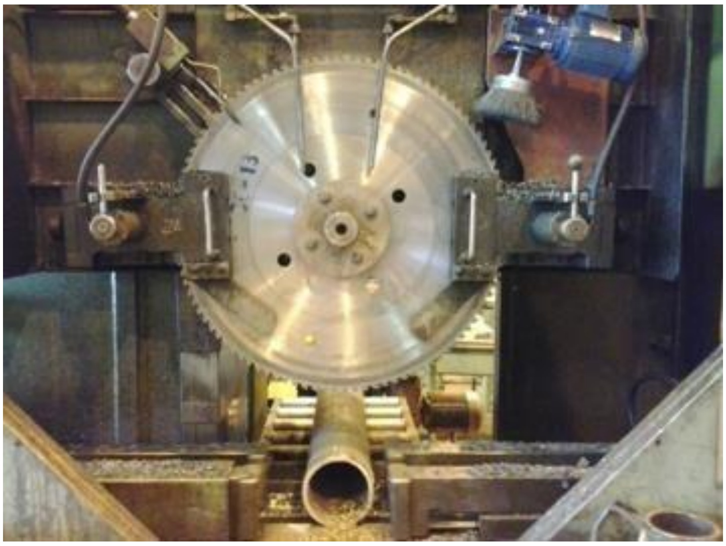

Figure 2. Equipment used for tests

The input quantities for the tests performed were: cutting speed and feed per tooth. Rings of approximately 40 mm in length were cut in order to make the most of the length of the tube. Initially, two test configurations were used with the conventional saw (uncoated) in order to identify the best operating condition of the saw, and, in each of them, two tests were performed to obtain greater reliability in the results found, according to table 1. It was found that, in the second test configuration, the blade presented better results both in function of the number of cuts performed and in the time spent. Therefore, this combination of parameters (cutting speed and feed per tooth) was used to perform the tests with the coated circular saw.

Table 1. Configuration of the tests.

Configuration	Cutting Speed(m/min)	Feed per tooth (mm/tooth)	Tribological System
1	90	0,03	Uncoated Saw / Tube
2	115	0,08	Uncoated Saw / Tube
3	115	0,08	Coated Saw / Tube

The parameter that was used to determine the end of life of the circular saw was the surface finish of the cut rings. When there was too much burr formation and / or the steel began to deform plastically, the blade was replaced immediately and the next test was started.

3. EXPERIMENTAL RESULTS AND DISCUSSION

The results obtained will be analyzed in function of the improvements obtained with the change of cutting parameters, the coating used and the surface finish of the cut.

3.1. Improvement of Cutting Parameters

During each of the three test configurations, the tube rings being cut by the saw were separated and the saw surface was finished; so that this criterion could be used with end-of-life parameter of the saw. When the surface of the cut rings had a very poor finish and formed a lot of burr, the test was interrupted and the number of cut tube rings cut to that test setting was noted. The time taken to cut a ring in each of the test settings was checked. The tests were performed in duplicate to obtain greater representativeness of the results. The numbers of cuts obtained using the 3 different configurations are shown in table 2.

Table 2. Results obtained with test configuration.

Configuration	Cutting Time(s)	Number of Cuts	Tribological System
1	126	13/11	Uncoated Saw / Tube
2	42	17/17	Uncoated Saw / Tube
3	42	71/75	Coated Saw / Tube

It has been observed that with the increase of the cutting speed and the advance in test configuration number 2, there was an increase of approximately 30% in the number of cuts made by the circular saw. In addition, the cutoff time that was previously 126 seconds became 42 seconds. This result indicates that a small change in the cutting parameters can result in tool and lead time savings in the production process.

3.2. Coating

As shown in table 2, it is found that with the use coating saw, there was an approximately 330% increase in the number of cuts when compared to the test set # 2. As the cutting parameters (feed rate and speed cuttings) remained the same as in configuration 2, there was no change in cutting time of the sawing process. This result indicates that the use of tribological coating on hard metal inserts can lead to a significant increase in process productivity.

3.3. Cutting Surface Finish

At the end of each of the test configurations, the cut tube rings were separated in the first test and the cut surface finish was analyzed. To better illustrate the surface finish throughout the cutting process, the first, the intermediate and the last cut tube ring were picked up. In the case of test configuration number 1, the chosen rings were # 1, # 6 and # 13; in configuration 2 the rings were # 1, # 8, and # 17, and lastly, configuration 3, rings # 1, # 27, # 50 and # 71. These rings obtained using the different test configurations are shown in Fig. 3, 4 and 5.

Figure 3 – Surface finishing of the rings in test configuration number 1

Figure 4 – Surface finishing of the rings in test configuration number 2

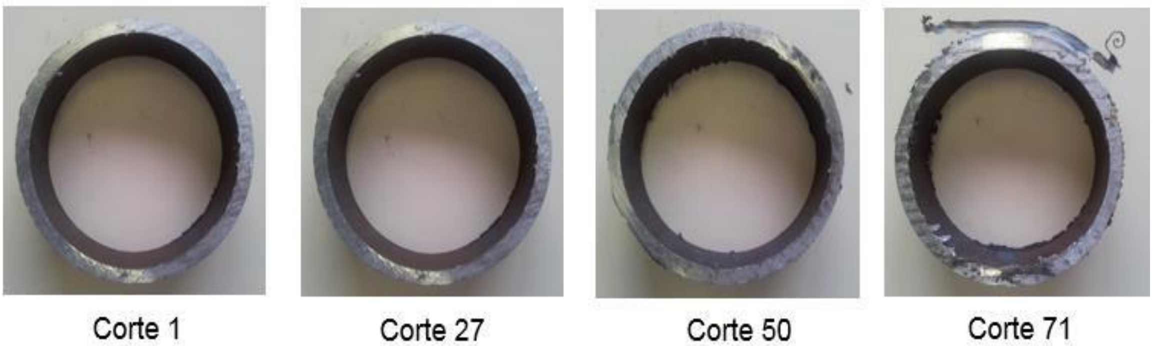

Figure 5 – Surface finishing of the rings in test configuration number 3

It can be seen that in the test configuration #1 the surface finish of the intermediate part (ring # 6) is already poor, since a lot of burr is formed and this is detrimental both to the process and to the safety of the operator. In the last cut (ring #13), in addition to forming a lot of burr, the steel begins to deform plastically and it is noticed that the temperature in the region of the cut increases greatly as the surface changes color.

In test configuration #2, the surface finish of the intermediate part (ring # 8) is already a bit better when compared to the corresponding part in the previous configuration. A smaller amount of burr is also formed. Already in the last cut (ring # 17), there was practically no plastic deformation and no burr in the material.

In test configuration #3, it can be seen that the surface finish is very good in practically all the cut pieces. There is almost no formation of burr and plastic deformation is also not evident. Note that in the last cut, the surface finish begins to get bad where the appearance of burr in the cut material occurs.

4. CONCLUDING REMARKS

After the tests of sawing in the stainless steel with the circular saws with inserts of carbide it can be concluded that:

- With the increase of the cutting speed and the advance in test configuration #2, there was a significant increase in the number of cut pieces and the cutting time.
- With the use of coated saw by the PVD process and the modified cutting parameters in test configuration #2, a number much larger than that obtained in the previous step was reached in test configuration #3.
- The surface finish was affected by the cutting speed and the feed rate. When these two parameters were increased (configuration #2 and #3), there was a significant improvement in the surface finish obtained, and with the use of the coated saw, the surface finish was the best of the three cases.

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6. RESPONSABILITY

The author is the only responsible for the printed material included in this paper.