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Experimental Study: Surface Roughness Analysis on Insert Molds with Grinding Wheel Types Variant

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ABSTRACT

In the era of industrial digitalization (Industry 4.0), more and more products were made from polymer (Plastic) material which was produced in the hope that it could be recycled or zero waste. When during mass production, especially product defects in the quality of surface roughness, the results of the injection mold process for plastic materials become one of the issues that cannot be ignored at this time. The amount of market demand for the quality of demand can be a determinant of the success of a production process. By using material ASTM P2 Mold Tool Steel as an insert mold that must be maintained the level of smoothness of the surface. One of them is by using surface grinding process with variations of grinding wheel of Pink Aluminum Oxide (PA) - Vitrified (V) type with Medium (48 & 60) and Fine (80) grain types which will be tested with a surface roughness tester. After testing, it was found that using PA 80.8.V grinding wheel type with cutting fluid type dromus oil had the most subtle surface roughness value, which is 0.119μm.

KEY WORDS: *Mold Insert, ASTM P20 Mold Tool Steel, Surface Grinding, Surface Roughness*

NOMENCLATURE

ASTM	American Standard Testing and Material
μm	Micro Meter

1.0 INTRODUCTION

In the current 4.0 industry generation, large quantities of production demand cannot be avoided, one of which is through an injection mold process for polymer and rubber products [1]. When designing plastic molds [2] it is of course obligatory to consider various factors, one of which is maintaining the surface roughness. This is to minimize product defects that will be produced. Insert mold is a vital part and must be maintained with smooth surface quality. For example, according to Rajalingam [3], the amount of costs that must be incurred to maintain the surface quality of the insert mold is much cheaper compared to making repairs after an experiment.

According to Zazkya [4], Afrian [5], and Shaji [6] to overcome surface quality problems, it can be done in several ways, including analyzing the effect of grinding stones and cutting fluid on the surface roughness value of workpieces.

Therefore, according to Stanek [7] to obtain the results of surface roughness and to maintain the quality of the insert mold is a surface roughness test. In this experiment, it was carried out with a variety of grinding stones [8] with ASTM P20 Mold Tool Steel material [9] as the control variable.

2.0 EXPERIMENT METHOD

This study uses an experimental method that uses ASTM P20 Mold Tool Steel [9], surface grinding machine CHEVALIER brand SUPER-618 Type, Cutting fluid Dromus oil [5], Mitutoyo SJ-310 [4], [10] as a measuring tool for surface roughness using DIN 4763: 1981 as the basis for the value of surface roughness. As for the grinding wheel, we use three variants namely PA.46.8.V, PA.60.8.V, and PA.80.8.V.

In Figure 1, the workflow experiment that we did was starting from measuring the surface roughness of the specimen before doing surface grinding for three times of data collection, then we processed the surface grinding process using three grinding wheel variants, and ended with a surface roughness measurement with rated using the average method to get the final data.

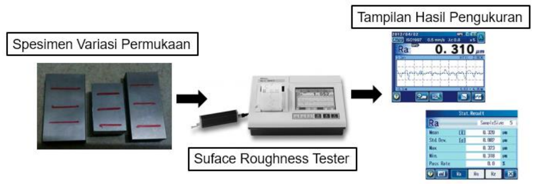

Figure 1: Experimental Apparatus and Method

3.0 RESULT AND DISCUSSION

Based on the test data that has been done with the method above in Figure 2 and Figure 3, the test results obtained that for the ASTM P20 Mold Tool Steel material [9] after milling the process has an average surface roughness value of 4.34µm.

Figure 2: Original ASTM P20 Tool Steel Surface Roughness Data

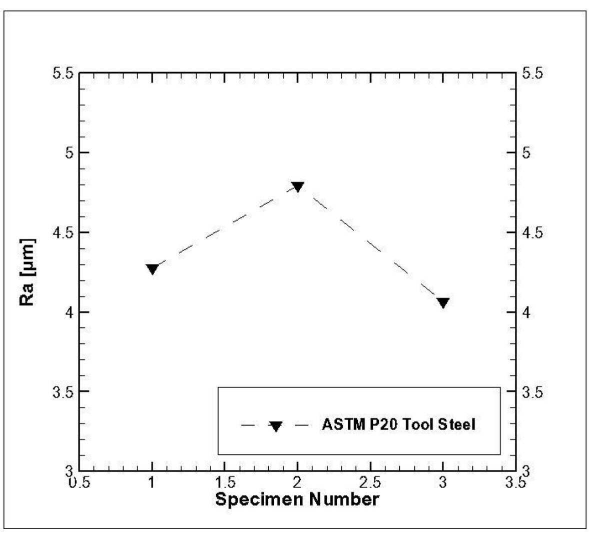

Figure 3: Graphic Data of Original ASTM P20 Tool Steel Surface Roughness Value

Experimental data using the three types of Grinding Wheel has been presented in Figure 4 which shows a significant and easy difference in concluding which Grinding Wheel has the most subtle surface roughness value. For more details regarding the explanation of each data, will describe the following:

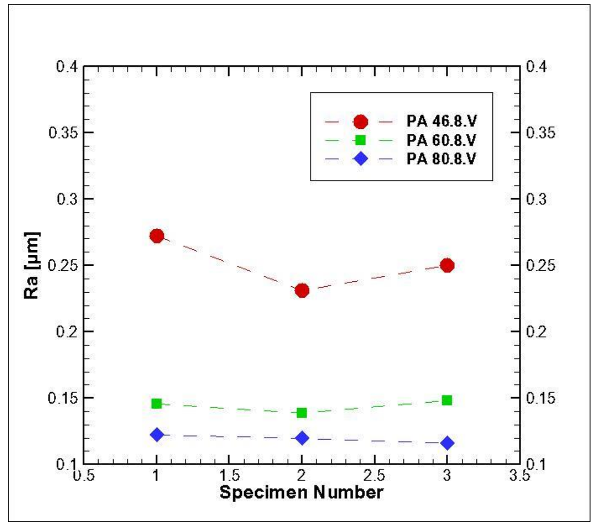

Figure 4: Experiment Surface Roughness Data

Based on Figure 5, the data from the ASTM P20 Tool Steel test results after grinding the process using PA.46.8.V grinding wheel type has an average surface roughness value of 0.251µm.

Figure 5: Measuring Result with Grinding Wheel PA.46.8.V

Based on Figure 6, the test results of ASTM P20 Tool Steel material after grinding the process using PA.60.8.V grinding wheel type has an average surface roughness value of 0.148µm.

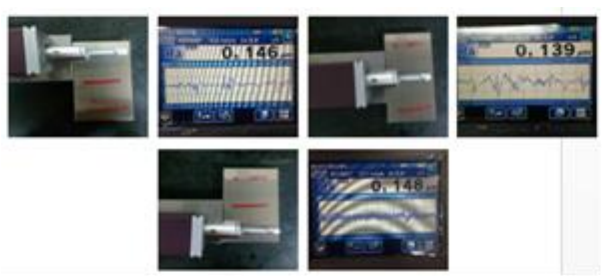

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Figure 6: Measuring Result with Grinding Wheel PA.60.8.V

Whereas based on Figure 7. the test results of ASTM P20 Tool Steel material after grinding the process by using PA.80.8.V grinding wheel type has an average surface roughness value of 0.119µm.

Figure 7: Measuring Result with Grinding Wheel PA.80.8.V

4.0 CONCLUSION

Based on the experimental results, it can be concluded that the material ASTM P20 Tool Steel which is a type of low carbon steel with a surface roughness of 4.34µm (N8) can obtain the smoothest surface roughness by using PA 80.8.V type grinding stone with a value of 0.119µm or equivalent to surface roughness N3 level.

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