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Grinding Problem of Center-Less Grinding Aluminum Tube in Polishing Process

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ABSTRACT

Aluminum was a hard and soft material and it was easy to generate grinding heat, so polishing was relatively difficult. The finer-grained elastic rubber grinding wheel (FGERGW) has been used to polish the center-less grinding aluminum tube (CLGAT) to reduce the grinding temperature. For the grinding problem of the CLGAT, an excellent polishing efficiency was achieved using the FGERGW and the feed rate of grinding wheel (FROGW) was not necessary to reduce. The effect of removing tool marks was excellently reduced high grinding temperature.

Keywords: Aluminum, Finer-Grained Elastic Rubber Grinding Wheel (FGERGW), Center-Less Grinding Aluminum Tube (CLGAT), Feed Rate of Grinding Wheel (FROGW), Grinding Temperature

INTRODUCTION

Aluminum has been used as a processing material due to its excellent properties such as lightness, corrosion resistance, non-magnetism, alloy strength, electrical conductivity, weight, and heat dissipation (Talebi-Anaraki et al., 2020). An example was on the front fork tube of a bicycle, which was only composed of two hollow straight pipes at the bottom. The top was mainly connected to the frame and the steering handle, and the bottom was connected to the wheels. When the front fork was installed in the frame, it could rotate freely, and so that the vehicle could steer. An important process was to reduce the defect rate of the anode in the later stage, remove the knife marks in the previous process, and improve the overall surface roughness. However, if the grinding temperature was too high, the aluminum tube was prone to defects in polishing process, and then selecting polishing wheels were a very important issue. Regular expansion, when the normal the feed rate of grinding wheel (FROGW) was performed under such conditions, after the temperature drops, the principle of thermal expansion and contraction would cause the total grinding amount to be more than originally expected, which was already excessive FROGW, and the dimensional accuracy was poor. High temperature was also easy to cause color difference on the surface of the aluminum tube, resulting in an increase in the defective rate. On the other hand, when the wool and linen wheels were generally used for polishing with high grinding temperature, and then these polishing wheels had a small cutting force and consumed a lot of high-precision polishing. Simultaneously, the knife, which was marked in the previous process, was difficult to remove, and the frequent replacement of polishing was required. The problem of increasing the number of wheels and polishing passes, these problems would indirectly affect the efficiency and yielded of the overall process (Eskin, Katgerman, & Mooney, 2004; Nam, Requena, & Degischer, 2008; Finkelstein & Husnullin, 2018; Vu et al., 2019).

OBJECTIVE OF THE STUDY

In this study, the objective would focus on the grinding problem of the Center-Less Grinding Aluminum Tube (CLGAT) (Figure 1) using better polishing wheels (i.e. to avoid high temperature in polishing process), which were suitable to use i.e. corresponding to the thermal expansion and contraction in polishing process according to the variants of temperature. Pre-anodic polishing, thermal expansion of the tube was a very important issue that may cause high temperature. Such problem often occurred in the polishing before the anode (Denkena, Reichstein, & Hahmann, 2007; Hashimoto et al., 2012; Hashimoto & Iwashita, 2020; Safarzadeh et al., 2021).

Figure 1: A type of the Center-Less Grinding Aluminum Tube (CLGAT)
Source: Hydro Co., Ltd

A FINER-GRINDING METHOD TO REDUCE TEMPERATURE

To solve the polishing problem as stated in section 1, the finer-grained elastic rubber grinding wheel (FGERGW) were recommended to use in this study. The FGERGW was provided from Seya Industries Co., Ltd (Figure 2). The polishing experiment was performed in the same laboratory with the same room temperature (20°C), relative humidity (RH) (60% RH) as using the coarser-grained polishing wheel (CGPW) (Figure 3). The operating procedure was the same as using the CGPW in order to make prominent the excellent polishing efficiency using the FGERGW. Unlike the CGPW, the FGERGW was more elastic and could fit the surface of the work piece. The effect of removing tool marks was excellent. If the surface of the work piece was more demanding, the FGERGW was recommended. The problem of heat generation could also be effectively solved. At high temperature, in polishing process, the cutting force of the grinding wheels was reduced and became friction on the surface. The cutting force of the FGERGW would be stronger than that of ordinary polishing wheels, so they would reduce the cutting force. Simultaneously, the FROGW was not necessary to reduce using such FGERGW in polishing process. Therefore, a good grinding effect could be achieved because the grinding wheel would rebound when pressing against the surface of the work piece, and the high pressure could remove the tool marks and improved the overall efficiency.

Figure 2: Finer-grained elastic rubber grinding wheel (FGERGW)
Source: Seya Industries Co., Ltd

Figure 3: Coarser-grained polishing wheel (CGPW)
Source: LUKAS-ERZETT GmbH & Co. KG

DISCUSSION

Aluminum was a hard and soft material because of its high toughness, and it was easy to generate grinding heat to cause high temperature in polishing process. However, as long as it was matched with a suitable grinding wheel, good results could still be achieved, but the accuracy was affected, except for grinding wheels and polishing wheels. In addition, cutting oil, filtration system, processing environment, etc. affected the processing efficiency, especially the yield rate, all of which affected the whole body. All details must be carefully considered to achieve the best processing efficiency. In order to avoid thermal expansion, two traditional methods were usually used. One was to use a CGPW, because of the coarser particle size, the gap between the abrasives was large, and the heat dissipation capacity was relatively enhanced, thereby avoiding grinding heat, but this method made the surface coarser. The degree of polishing couldn't be effectively reduced, especially after anodizing. If the polished surface of this section was not good, it couldn't be remedied after anodizing, so the risk was too high. The second method was to reduce the FROGW of the CGPW. Although it was a very direct method, the impact was also very intuitive, that was, efficiency and time. If the FROGW was reduced, the number of polishing would increase, which was equivalent to bringing the entire batch back to the back. Throwing it away, or buy another one, solitaire-style throwing, no matter which one was the increase of time and cost, so the effect of this method was limited. Therefore, based on such problem, the use of the FGERGW was recommended and then could fit the surface of the work piece. The effect of removing tool marks was excellent to reduce high grinding temperature and reducing FROGW was not necessary. Therefore, an excellent polishing efficiency has been achieved using the FGERGW for the grinding problem of the CLGAT.

CONCLUSIONS

Aluminum was a hard and soft material because of its high toughness, and it was easy to generate grinding heat, so polishing was relatively difficult. However, as long as it was matched with a suitable grinding wheel, good results could still be achieved, but the accuracy was affected. Therefore, the FGERGW has been used because it was more elastic and could fit the surface of the work piece. The effect of removing tool marks was excellent, and such removing to reduce high grinding temperature has confirmed the use of the FGERGW to be a polishing excellent method for the grinding problem of the CLGAT. Simultaneously, reducing FROGW was not necessary.

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CONFLICTS OF INTEREST

The author Jyh-Woei Lin declares that there are no conflicts of interest.

AUTHOR CONTRIBUTIONS

Jyh-Woei Lin designed the study and wrote the paper.

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