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論　文　内　容　の　要　旨

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Eco-friendly manufacturing associated with energy saving has become common request in today's industrial activities. Enhancing machining performances for the improvement of product's quality, time-saving, and low-cost production are also essential. One approach to enhancing machining performance is to apply cutting fluids during machining. However, the usage of cutting fluids in machining process has effects on both environment and human health. Meanwhile, usage of water in machining is still restricted. Therefore, the objective this study is to developed some countermeasures for utilizing water during machining and at the same time reduces the environmental impact. Thus, the alternative cooling of using strong alkaline water was proposed and evaluated to obtain its impacts on these aspects. In this study, some proposed techniques for using water during machining were developed. Since resonance of a machine tool is difficult to avoid without changing the cutting condition, therefore, the simple and easy technique to change machine tool resonant frequency was developed in order to maintain the cutting condition. In this study, the use of the water mixed with polymer PEO to change machine tool resonance frequency is proposed. To achieve the optimum result, this method was combined with the reinforcing of machine structure and the changing of the position of support's point. The effectiveness of this study was later evaluated by the real cutting experiment to measure the surface roughness of the cutting result. It was observed from this study that water can be used to change the machine tool resonance. Besides using water for controlling machine resonance, a new cooling technique of using strong alkaline water for drilling was also developed. Since strong alkaline water consists of 99.9% water, the test by submerging various types of machine tool related materials in it was firstly performed to investigate the effect of strong alkaline water in inducing corrosion. For improving cooling efficiency, the method by supplying strong alkaline water with microbubble was developed. The evaluation was later done by performing drilling test using a trough-hole drill. At final, the cutting tool life and cutting surface roughness are investigated and evaluated by experiments. Since the result of drilling by cooling using strong alkaline water is better than the conventional cooling, another cooling method was proposed by submerging the machine tool completely in the strong alkaline water. This method was proposed with an objective to suppress thermal deformation of the machine tool. In the evaluation of this method, the changes in the temperature of machine body without submerging, with submerge condition in the strong alkaline water, and by adding with microbubble were all investigated. The thermal deformation of the bench lathe machine was measured and compared. Since cutting evaluation using the bench lathe machine during immersion condition is difficult, the evaluation was performed by cut under strong alkaline water using the NC milling machine. Lastly, the tooltip temperature, the cutting tool life, and the cutting surface roughness are all investigated and evaluated by experiments. In addition, the simple assessment of the environmental

impact is also performed by comparing the conventional wet cutting and cutting using cooling of strong alkaline water.