



A new approach to cold extrusion process: Dimples indentation on sliding contact surface and palm oil as an alternative lubricant

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Abstract. Surface texturing is one of the economic solutions to die modification if compared with tool change and hot works. In extrusion die design, it has become increasingly common to add dimples to maintain lubricant flow along the metal forming process. For that reason, this research was done by embedding dimples in a tapered die sliding contact surface to explore its effectiveness in a finished product of cold extrusion process. Besides, an alternative lubricant from palm oil was also tested, and mineral oil was used for comparison purposes. As a result, dimpled tapered die may help decrease the extrusion load of cold extrusion process, leading to finer surface roughness of extruded product. Palm oil-based lubricant also presents similar results to those of mineral oil, meaning that palm oil has a potential to be considered as a new metal forming lubricant in the future.

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1. Introduction

Tribologically, the main purpose of applying lubricant into metal forming process is to act as an agent for reducing friction and severe wear on contact surfaces [1-9]. Mineral oil is the most commonly used lubricants throughout industry. They are petroleum based used in applications where temperature requirements are moderate. Typical applications of mineral oils are applicable to gears, bearings, engines, turbines, etc. [3,10].

Palm oil is one of the commercial vegetable oils that has a big potential to be expanded to other industries such as automotive [11], marine, bio-diesel [12-

14], and metal forming [7,15-18]. As a vegetable oil, it can be categorized as a renewable resource because such resources will remain as long as trees are still planted. Caminaga et al. [15,16] successfully conducted an experiment using various types of potential plant-based lubricants, and found that the surface roughness and the dimensional quality of the products extruded with these alternative lubricants are similar to those found in the standard tests.

As mentioned earlier, lubrication is fundamentally used to control wear and friction between two contact surfaces. An alternative approach has been implemented by few researchers to maintain a lubricant flow along the metal forming process. Surface texturing is among the low-cost solution to modification die if compared with tool change, hot works, and others. In extrusion die design, it has become increasingly common to add micro-pits to balance the metal flow. The balance of metal flow is particularly important for multiple cavity dies or sections with varying thickness in order to maintain a uniform velocity profile across

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