THESIS

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EFFECT OF DIFFERENT FORCE AMPLITUDE VIBRATIONS TO FRICTION

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Summary

I started this project work by giving a short introduction to the phenomenon of friction and vibration in the first chapter, describing how vibration affects friction, the studies done to reduce friction during vibration, and how vibration has been used to reduce friction in recent years. Still, in this chapter, I explained why I chose PTFE and PE HD 1000 as materials for the tests (for example, for their quality, the excellent properties, and the countless advantages they present as the multiple applications both in industries and in our daily lives). In chapter 1.1 I described the importance of this work and the objective of the work in chapter 1.2. The fundamental objective of this work is to perform friction using different amplitudes of force on the selected material. In my case, I used polymers as specimens. I set the radius of the sliding path, the sliding velocity, the normal direction force to fix values, and I investigated how the coefficient of friction was affected by the amplitude of normal vibration. I used S235 as the disc and two different types of polymers as the pin. In the second chapter of this work, there is a literature review in which important sub-themes are divided, which allowed me to elaborate a more complete work. This chapter gives a description of polymers, their properties, materials used, industrial applications, what they are, how they are made, and how they are found in nature. Some important concepts such as polymerization, polycondensation, and polyaddition were defined. I also described vibration in machines, what it is, how to reduce vibration in milling and turning, the biggest challenges in friction-vibration interaction problems, and an overview. I also defined important concepts such as friction, lubrication, wear, tribology (the science and technology of the interaction of surfaces in relative motion and related subjects and practices (Standard DIN 50323). Also in this chapter, I made a small comparison between polymers and metals, focusing on the important differences between both materials. Polymer is a macromolecular material with many repeating units linked together by covalent chemical bonds, while metals are pure elements or alloys. The main difference between polymers and metals is that polymers are lighter, so they can be transported more easily and are cheaper to produce than metals. But metals have a shiny appearance and high thermal and electrical conductivity. In addition, polymer materials have a higher strength-to-weight ratio than metals. Another important difference between polymers and metals is also that metals are very flexible and malleable while most polymers are not. On the sub-theme about vibrations in machines, important concepts were defined such as imbalance, misalignment, wear, and looseness because these are some factors that can cause vibration in machines. In the last sub-themes in the literature review, I described what is tribometer that was originally developed by Da Vinci and

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explained the pin-on-disc method that consists consists of bringing a pin close to a rotating disk, which will result in a wear track on the disk. In the third chapter, I presented the materials and the method that was used to carry out the tests. Small-scale tribotests were carried out at the Institute of Technology in the Mechanical Engineering department in Gödöllő on engineering plastic samples. In the experiments of this study, the tribological behavior of polymeric materials in dry sliding contacts was analyzed. Surface of roughness was calculated and the alverage roughness was 0.10-0.17 μm. Also in the third topic, I presented the pin setup on the tribometer disk, how the collected data was made. Two test categories were used in the experiment: dry contact and low-frequency vibration addition, with a frequency value of 23 Hz. For testing purposes, a 21N external load and a 48 RPM rotational speed were applied to the steel disc. In order to get a better coefficient of friction result, the tests lasted 20 minutes. Three levels of testing have been performed on each test. A vibration unit was put into the top of system and the electric motor drives a small gear which drives a big gear and the big gear is connected to one shaft. 3 levels of vibration ws used to measure the amplitude of the friction coefficient. The first level was zero because it was stationary level. In the second level, I put the vibration on top of the measuring system and started the vibration unit, only with 4 screws.

In the third level, I used mass and it generated a bigger amplitude force. I only used 3 levels because it is new research and I do not know if anybody ever investigated the effect of amplitude of the coefficient of friction. In case of vibration load I measured it three times.

Not least, in the last chapters I presented the conclusion in chapter 5, resume in chapter 6, summary in chapter 7, references in chapter 8 and appendix in chapter 9. When a small vibration was added and a normal load of 10 N was applied, the effect of force amplitude for PTFE on the coefficient of friction for PE HD 1000 was very insignificant.