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WEAR PERFORMANCE OF AISI 304L STAINLESS STEEL UNDER VARIOUS AMBIENT TEMPERATURES

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Abstract— **AISI 304L steel is widely preferred in many fields such as pipe sector, biomedical and nuclear industry due to its wear behavior and good machinability. In this experimental study, temperature-dependent wear properties and worn surface structures of AISI 304L steel were investigated. All tests were conducted by using pin-on-disc test equipment under unlubricated conditions. As ambient temperatures, 25°C, 50°C, 100°C, 150°C, and 200°C were selected. The results indicated that the main friction properties, wear mechanisms, and wear rate of the worn steel samples were significantly affected by altering the test temperatures. It was observed that the friction coefficient oscillated at lower temperatures, but this case was quite different at higher temperatures. Micro observations showed that mixed deformation characteristic dominated by adhesive wear was observed between 25°C and 150°C while abrasive wear became more effective between 150°C and 200°C. Moreover, wear rate and specific wear rate values increased until 150°C, then dropped as a result of changing the wear mechanism and contact surface structure.**

Keywords— **Wear; Friction; AISI 304L; Hardness; Dry-sliding**

I. INTRODUCTION

AISI 304L steel is a low carbon version of the widely used austenitic AISI 304, and is frequently preferred by various industrial areas such as construction, ocean engineering, pipe sector, oil industry, nuclear industry, food processing, kitchenware and bio-medical (Hu *et al.*, 2020; Kang, 2020) because of their high oxidation and corrosion resistance, wear performance, good machinability and weldability (Davis, 1994). Even though oxidation and corrosion resistance are the most common reasons for stainless steel usage (Karjalainen *et al.*, 2018), in recent years, the wear resistance has also become a significant criterion considering the increasing demands from different industrial areas. On the other side, AISI 304L steel is sometimes exposed to high temperatures during the real industrial applications. At this point, if AISI 304L steel is handled specifically in terms of high temperature using purpose, some examples can be given. For instance, AISI 304L is widely used as heat transfer tube in spiral-wound heat exchanger in nuclear power plants (Lei *et al.*, 2020). Additionally, it is also utilized as nuclear pump components subjecting to serious potential friction, triggering heat release. Aside from nuclear industry, AISI 304L has a noteworthy market share in pipe industry. Pipe fittings carrying hot liquids and hot gases may be contaminated with undesired particles, which leads to friction on pipe walls. On the other hand, in the food sector, AISI 304L is an ideal material for many kitchen equipment and utensils. These items are frequently subjected to wear at high cooking temperatures due to other secondary elements like mixing and cleaning elements. This kind of undesired cases can be risky for human health in long-term usage. Lastly, AISI 304L parts are used in the petrochemical industry as nozzles, top separators and central pipes (Ravindranath and Alezemi, 2019; Wensley *et al.*, 2008; Wensley, 2000). Following chemical reactions occurred at high temperatures, tribological features of 304L parts may alter. Depending on their application diversity (from pipelines to gas heater systems), different kinds of high-temperature failures were reported by different researchers (Luder *et al.*, 2016; Bahrami and Taheri, 2019) for austenitic stainless steel of 304L. It can be also seen from these findings that the correct understanding of the temperature-based wear mechanism of AISI 304L is notably significant since there is a risk of solid contaminations in the pipelines or gas heater systems. In addition, by way of this experimental effort, probable wear precautions can be predicted more easily owing to the fact that the principal mechanisms were discovered.

Until now, the investigations on the tribological properties of AISI 304L has focused solely on the wear behavior at room temperatures. In this context, Qin *et al.* (2017) and Wang *et al.* (2009) focused on surface treatments like nitriding to improve the low temperature wear resistance of AISI 304L. Rozing *et al.* (2016) discussed acidic media influence on the tribo-corrosion behavior of AISI 304L, and revealed that usage of AISI 304L steel for vegetable oil screw press equipment could provide good tribo-corrosion resistance. Saada *et al.* (2018a) explored that nanocrystallized layers formed on AISI 304L increased the wear performance. Guoquing *et al.* (2012) conducted wear tests on AISI 304L at room temperature, and found out that measured wear rate values went up with the increasing test forces. Saada *et al.* (2018b) studied on the tribological perfor-