Corrosion Test Report

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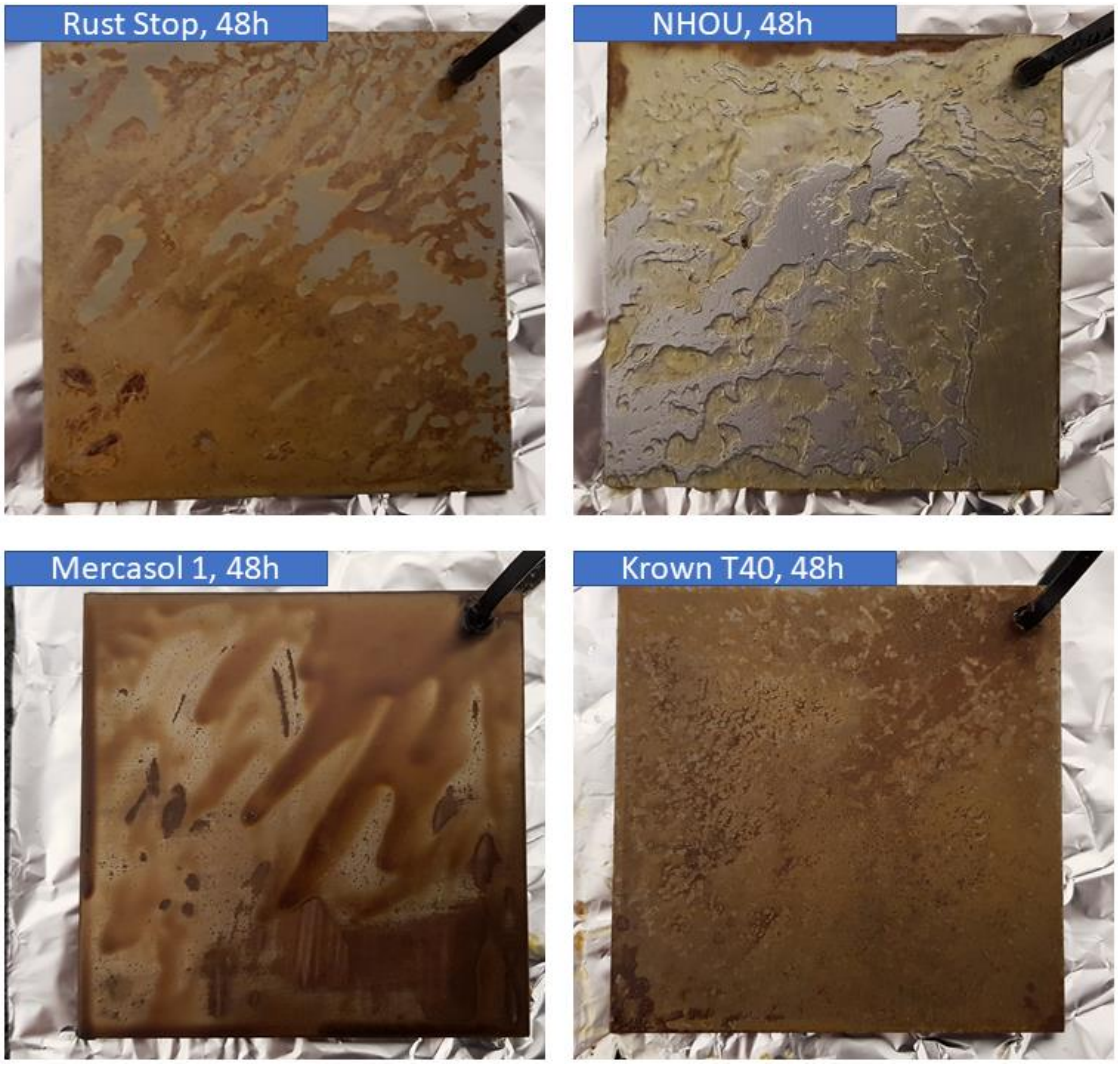
Introduction

The study on anti corrosion oils was carried out for SIA Auto Truck Studio as a service in order to compare the performance of different products. For that purpose, Machu test (an accelerated corrosion test) was used, which contains NaCl, H_2O and is acidified to pH 3 with acetic acid. Tests were carried out with low carbon steel plates, that were polished prior to testing with a steel brush. The polished substrates were then coated with oil from all sides, including edges. The NHOU and Rust Stop coatings were applied via spraying. The Mercasol 1 (brown bottle) and Krown T40 (white bottle with green cap) coatings were applied with a brush. After the coating process, the samples were hung with plastic cables to dry over 24h, which was followed by the Machu test. The Machu test lasted 48 hours and the samples were photographed before, during and after the test. Prior to making the final photos, the samples were also dried 24h in open air.

Results

The corrosion tests showed that all oils improved the corrosion resistance of the easily corroding low carbon steel alloy (Fig. 1). However, the best performance was observed for the substrate, that was coated with the NHOU oil (Fig. 1, NHOU, 48h). In particular, the middle part of the sample exhibited no extensive corrosion, except for a few small sites. Only the top part of the sample had suffered some corrosion, which can possibly be explained by the oil flowing away from the sharp edge during drying prior to testing. The worst performance was observed for Krown T40, which included many sites of corrosion and was also covered with rust (Fig. 1, Krown T40, 48h). The sample with Mercasol 1 coating (Fig. 1, Mercasol 1, 48h) contained several larger patches of corroded areas but the sample was generally intact. The sample with Rust Stop coating (Fig. 1, Rust Stop, 48h) exhibited mild corrosion across the whole surface. The exceptionally good performance of the NHOU coating can possibly be explained by its application method. Namely,

the NHOU coating was applied by spraying, where the spray was in the form of an expanding cone of aerosol particles. Those aerosol particles then formed a uniform coating on the metal plate, which was nearly free of defects and thus prevented corrosive species from reaching the metal substrate. In contrast, the Rust Stop oil entered as a single jet out of the bottle and this possibly resulted in a coating of poorer quality. The Mercasol 1 coating was also quite good, exhibiting only a few sites of corrosion, but the fact that it has to be applied via a brush, makes it less user friendly than the NHOU oil. By excluding the edges and considering the middle part of the plates with highest quality of coating, the percentage of corroded area per sample could be estimated follows: Rust Stop <80%, NHOU <5%, Mercasol 1 <30%, Krown T40 100%.



Joonis 1. Photos of coated 90x90 mm plates after 48h machu test when the samples had also dried for 24h in open air.

Proposals for future studies

Although the best performance in the accelerated corrosion test was observed with the NHOU oil coating, we propose the following studies to verify the results.

a) Long term (1000h) immersion test for all coated substrates in a) neutral salt water, b) acidified salt water, c) alkaline salt water. This test will show the long-term performance of coatings when exposed to corrosive mediums typically encountered in real applications.
b) Electrochemical tests for coated substrates for all coated substrates in order to evaluate the dielectric properties of coatings and also coverage of metal substrates. In this experiment an anodic voltage is applied while the sample is immersed into corrosive medium. At the same time current is measured, which describes the performance of the coating. Samples with dielectric coatings, that are free of defects, should exhibit lower current values in this experiment.
c) Machu test, immersion test and electrochemical test for other alloys (e.g. aluminium and copper) coated with the 4 types of oils. These tests would demonstrate the usability of the coatings in a broader range of applications.
d) Enhancing of NHOU oil. The oil can possibly be enhanced by including corrosion inhibitors into its mixture, which would limit corrosion even if there are some parts of the alloy that were not properly coated. Also, different nozzles and propellant gasses can be tested with the oil, which may improve its performance and efficiency of coating process.

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