

TITLE: Lubricant and Grease Additives for Immobilizing Machinery

TYPE EFFORT:

PROPOSED BY: Dept.1841 and Dept.1832

CAPABILITY SOUGHT AND POTENTIAL USES: We propose to develop formulations containing abrasive particles plus surfactants and dispersants that can be added to wet lubricants and transform them into abrasives. Additives that alter viscosity will also be investigated. The results of these different approaches will be compared. Additive concentrations that should be added to impair the performance of a volume of lubricant (In a crankcase or a storage container) will be determined.

DESCRIPTION: There are numerous ways to alter a lubricant's composition and destroy its lubricant properties. One method is to add abrasive particles to a lubricant. In order to optimize the effect of an abrasive addition agent, it is important to tailor particle size and add surfactants and dispersants that will keep abrasive particles in suspension. Another approach is to alter lubricant viscosity. A variety of commonly available materials, e. g. polystyrene and polymethylmethacrylate will increase viscosity, decrease engine efficiency, increase engine heating and accelerate failure. Solvents such as gasoline reduce viscosity and lubricant efficiency. During use, water in oil forms an emulsion that has little lubricating capability. Adding surfactants to water may promote the formation of an emulsion. Adding ferric chloride to the water may corrode steel or aluminum alloy parts contacted by the altered lubricant.

We propose to quantitatively measure the effects of these different approaches for doctoring lubricants and greases. Friction coefficient and wear rate will be measured as a function of load and temperature, for sliding motion and rolling motion, for candidate doctored lubricant formulations that have been stored for varying amounts of time.

The design of lubricant and grease additives for immobilizing machinery requires an understanding of how fundamental materials properties and interactions affect failure rates. We propose a computational analysis to investigate materials effects (i. e. wear rate and failure rate) as a function of lubricant poisoning. The development of a computer model that is able to predict or simulate failure schedules and failure modes produced by different types of lubricant poisoning is an important component of this study.

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The goal of this work is to develop methods of poisoning lubricants so that rapid or predictable delayed failure of the lubricated machinery can be produced. Ultimately we propose to report the volume of a variety of additive formulations that must be mixed with oils and greases stored in drums or in use in accessible vehicles, and the failure schedule that can be anticipated.

RISKS AND LIMITATIONS: Apparatus and skills for evaluating lubricant performance have been developed at SNL to support earlier programs. Basic approaches for poisoning lubricants are known. The quantitative effects of these approaches need to be identified to develop a predictive capability for machinery failure. Candidate additive formulations need to be optimized.

Implementing this approach presumes access to vehicles or lubricant storage areas. If the operating loads and temperatures present in target vehicles are unknown, the failure schedule that ensues may be unpredictable.

PROJECT PLAN:

F.Y. 1. Set up bench top simulation experiments. Identify and procure promising poisoning materials and lubricant base stocks. Determine how to manipulate raw materials to prepare potentially useful formulations. Design and begin parameter screening experiments.

F.Y. 2. Complete screening experiments, begin modeling failure modes and undertake experiments to optimize the most promising approaches. Write a final report.

PROJECT COST:

F.Y. 1 \$150 K

F.Y. 2 \$200 K

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