WHAT'S EATING DISTILLATE FUEL THESE DAYS?

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Microbes, that's what! Diesel fuel, kerosene, gas oils . . . all serve as food for bacteria. The result is severe gumming of delicate components and corrosion of metal surfaces. To prevent trouble, the Author explains in this article how to outwit these hungry little devils. It was first published in Vol. 109, No. 1 of the American magazine Power *and is reproduced by permission of the Editor.*

Microbiologists, who specialize in the odder forms of life, have known for a long time that there are living things that eat hydrocarbons. Recently, operating engineers have also discovered that microbes, like most of the creatures living in petroleum, require water and are found at the interface where there are water bottoms.

A sample of No. 1 Diesel fuel and water bottoms taken from a storage tank showed a cloudy mess visible at the interface consisting mostly of bacteria, yeasts and fungi. The water phase contains about 100 million microbes per cu in., but those tiny devils increase to over 3 million at the interface. A sample of clear fuel from the top of the tank 17 ft above the interface contained a microbe population of over 10,000 per cu in.

These organisms can live indefinitely without free water, but, once they get it, they undergo a population explosion. If sterilized tap water is added to water-free fuel containing less than 100 microbes per cu in., the same thing happens in a few hours.

Micro-organisms have been found in everything from leaded aviation gasoline to melted paraffin wax, but their favourite diet consists of Diesel fuel, aviation fuel oil, kerosene and stove oils. Gasoline and cuts which are heavier than No. 2 stove oil rarely contain enough bacteria to cause much trouble. Kerosene, gas-oils, and some wide-cut fuels like JP.4 are the main targets.

Many microbes like a between-meal snack of aluminium, iron, sulphur, etc. The function of a fuel-control component made of 12 per cent stainless steel was destroyed after being in contact with contaminated fuel for only 100 hours.

Severe corrosion of both steel and aluminium fuel tanks has been traced to biological corrosion. In some cases there is a dispute between bacteriologists whether a given organism actually eats the metal or whether its excreta corrode it incidentally. Still, for all practical purposes, the results are equally disastrous.

A well-known metabolic byproduct produced by sulphur-eating bacteria is hydrogen sulphide which attacks many metals resistant to most other forms of corrosion—silver for one. Still other micro-organisms produce fluids which attack synthetic rubber and other non-metallic materials, such as seals and protective coatings. A microbe population also promotes gum and sludge formation in the fuel, causing a big headache to energy-systems engineers.

Another common annoyance from organic life in fuels is the choking of filters. The size of the individual organism averages $\frac{1}{2}$ to 3 microns, and some are surrounded by a layer of mucus or 'slime'. Unfortunately they are, as a group, the right size to get into the pores of a fine filter and plug it solid—a frequent occurrence.

In many reported cases the life of filter elements has been extended ten or more times. How? Simply by the elimination of micro-organisms from the fuel. Carbon deposits on Diesel injector tips and inside gas turbines are often associated with heavy bacterial fuel contamination. Although there are several theories, the simplest explanation is that the deposits are the charred corpses of billions of bacteria which usually do the harm.

Fuel direct from the refinery production unit is normally sterile. But before it leaves the refinery, it goes into a storage tank, and that's when the trouble starts. At the bottom of most storage tanks there is water alive with microbes.

Two methods of control are available. The first, and most important, is to always keep your tanks and systems clean and dry. While many of the microbes can live without free water, they do not thrive very well. Rust and dirt frequently act as fertilizers to encourage microbe growth. Be sure to drain or pump out your tank bottoms regularly, especially in underground tanks. Do this as soon as possible after heavy rain or thaw. One effective control method is to use two storage tanks alternately. Fill one while drawing from the other. Then, before switching over, let the tank that has been agitated and stirred up while filling, settle. A good rule of thumb for settling is at the rate of one hour per foot of depth of fuel. With one tank, allow as long as possible between filling and drawing-off and drain frequently.

It is good practice to use a floating suction which takes its fuel as far away

from any water interface as possible. If you do use a floating suction, make sure at least once a week that it is free and floating. Always avoid blind 'T' joints and other blind connections in the fuel lines, since these are breeding grounds for all sorts of obnoxious microbe life.

Another effective measure is to coat metal surfaces with epoxy paint or a similar inert preservative.

The second approach is to use germicides. This should be done together with, and not instead of, a general clean up. The reasons are: (*i*) the lower the population, the less germicide is required, and (*ii*) the bacteria living in oil are remarkably tough and adaptable.

It is true that the addition of many chemicals, such as tetraethyl lead and some alcohols, will cause a rapid drop in the microbe population of a fuel sample. But in a few days, or even hours, the survivors will have adapted themselves and will be happily breeding again. In some cases the adapted microbe is more prolific than the original form. It has been reported that some boron compounds, especially one originally developed as an additive for petrol, are permanently effective. If this proves true, it will be a great help, provided the cost is acceptable.

In conclusion, if mysterious problems of filter clogging, corrosion, sludge or gum formation—you name it—are haunting your distillate fuel systems, just remember our little friends, the microbes.