Glycol Oxidation

Category: Coolants
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Introduction:

The appearance of poorly processed redistilled glycols and the implementation of extended service interval programs have caused many questions to be asked as to the nature and meaning of glycol oxidation.

A Natural Degradation:

Ethylene glycol (EG) and propylene glycol (PG) are built of three elements: carbon, oxygen and hydrogen. Chemists diagram the way they are attached to each other very simply with letters.

EG: H-O-CH2-CH2-O-H PG: H-O-CH2-CH2-CH2-O-H Where CH2 looks like this: H-C-H

During the normal course of operation, some of these molecules pick up extra oxygen from the coolant's environment. When this happens, some compounds from the carboxylic acid family are formed. For example, in older, worn EG coolants analysts often can measure significant concentrations of formic acid, oxalic acid, and glycolic acid. You can see where the extra oxygen has sort of "moved in" on these molecules.

Formic Acid:

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    H
    /
H2C=O
```

Oxalic Acid:

```
H-O   O-H
   \  /
  O=C-C=O
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Glycolic Acid:

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      O-H
      /
H-O-CH2-C-=O
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These three compounds are all slightly acidic, and will pull the pH of the coolant down. If this is allowed to happen, the customer may experience problems such as drop-out or corrosion of certain metals. For this reason, properly formulated coolants have chemicals that prevent and offset the effect of the oxidation. These additives are called "buffers". Superior buffering technology and better, more air-tight cooling system engineering have combined to drastically reduce glycol oxidation, and have contributed to adoption of extended service interval programs.

Special Circumstances: Higher Operating Temperatures

Conventional antifreeze degrades as a function of time and temperature. In many of today's modern, low-emissions vehicles, operating temperatures have increased from those of years past. This trend is expected to continue, especially with the introduction of exhaust gas recirculation (EGR) systems. Gas temperatures at the entrance to an EGR may exceed 1,100 degrees F, and can destroy ethylene glycol coolants in a remarkably short period of time. Customers experiencing rapid premature failure in coolant systems should advise their Penray professional immediately, so that a thorough evaluation and corrective action can be taken.