Alternate Energy Systems, Inc.

A Corporation devoted to Energy-Oriented Needs

Corrosion Protection in Water Bath Vaporizers

How Does Corrosion Happen?

Corrosion, as opposed to oxidation, is an electrochemical process that occurs naturally in all metallic objects. In order for corrosion to take place, there must be a positively charged area called the anode, a negatively charged area called the cathode, a path for ionic current flow called an electrolyte, and a path for electronic current flow which is the metal. The difference in electrical potential between the anode and cathode in the presence of an electrolyte creates a galvanic cell, and a current flow is induced.

In any situation such as this, the current flow causes metal loss in the anodic area of the circuit, resulting in corrosion. If any of the aforementioned conditions for corrosion can be suppressed or eliminated, metal loss will be equally reduced.

An excellent example of this phenomenon is a typical car battery. The battery has metallic positive and negative terminals (the anode and cathode), and an acid/water solution (the electrolyte). Current flows from the high-potential anode to the low-potential cathode through the electrolyte. Corrosion is always prevalent on the positive terminal of the battery.

Water bath vaporizers likewise contain all of the “ingredients” for metallic corrosion. In order to minimize corrosion, certain steps must be taken. These steps include grounding the vaporizer skid, and addition of a rust-inhibiting antifreeze to the water bath. Grounding can be accomplished by simply attaching the vaporizer frame to a grounding rod via a 4 AWG or larger stranded copper wire. A brief discussion of the recommended antifreeze solution follows.

Sources: www.alliedcorrosion.com, www.cathodicprotection.com

Recommended Antifreeze

Alternate Energy Systems, Inc. recommends JEFFCOOL®-P150 inhibited propylene glycol based heat transfer solution. The product is manufactured by Huntsman International, and is available as pre-mixed at a 50% glycol / 50% de-ionized water ratio as JEFFCOOL®-P155. In addition to providing freeze protection, JEFFCOOL®-P155 heat transfer solution contains inhibitors that work to prevent corrosion of the metal parts inside the water bath (tank) of the vaporizer. A data sheet containing product information on JEFFCOOL®-P155 heat transfer solution is available for download from our web page, http://www.altenergy.com/Products/Vaporizers/HeatTransferSolution.htm.

JEFFCOOL®-P155 heat transfer solution is recommended because of its low oral toxicity and its “environmentally friendly” nature. The Environmental Protection Agency (EPA) does not list propylene glycol as a hazardous substance in any current environmental code.

Filling Procedure

The best option for adding the JEFFCOOL®-P155 heat transfer solution to the vaporizer is to procure the solution pre-mixed, and then add the pre-mixed solution to the vaporizer. The second best option is to mix the solution at the desired ratio on-site, using JEFFCOOL®-P150 heat transfer solution and de-ionized water, prior to filling the vaporizer. However, if neither of these options are available, the following procedure should be used to introduce the antifreeze solution into the vaporizer.

Calculate the proper quantity of JEFFCOOL®-P150 heat transfer and de-ionized water needed to achieve the desired result. This will depend on your geographical location, vaporizer water fill capacity, and the required temperature protection. Typically, a 50% glycol / 50% de-ionized water solution is adequate to provide burst protection to –60°F, and freeze protection to –30°F.

The calculations can be made using the following formulae:

(Water Capacity of Vaporizer in Gallons) x (Volume % JEFFCOOL®-P150 heat transfer solution from Specification Sheet)
= Gallons of JEFFCOOL®-P150 heat transfer solution needed to provide desired freeze protection.

(Water Capacity of Vaporizer in Gallons) – (Gallons of JEFFCOOL®-P150 heat transfer solution needed)
= Gallons of de-ionized water needed to fill vaporizer water bath.

- Introduce the number of gallons of water needed to fill the vaporizer water bath calculated in step 1. **Do not introduce the JEFFCOOL®-P150 heat transfer solution first.**
- Add the number of gallons of JEFFCOOL®-P150 heat transfer needed to provide the desired freeze protection calculated in step 1.
- Circulate the mixture for at least 24 hours to ensure proper mixing. Check the liquid concentration with a refractometer or other method to verify the correct mixture.

The mixture should be monitored periodically in order to ensure the proper mix ratio and water level. Some physical properties of propylene glycol solutions are listed in Table 1. Additional information and the MSDS are available for download at http://www.altenergy.com/Products/Vaporizers/HeatTransferSolution.htm.

Table 1, Physical Properties of Propylene Glycol/Water Solutions	100% Propylene Glycol/Water Solution	50% Propylene Glycol/Water Solution	25% Propylene Glycol/Water Solution
Molecular Weight	76.1	47.05	32.5
Freeze Point	-71 °F	-29 °F	15 °F
Specific Gravity	1.033	1.050	1.026
Density in lb/ft^3 @ 70 °F	64.32	65.14	63.95
Flash Point	220 °F	None	None
Boiling Point	369 °F	222 °F	214 °F
Vapor Pressure in mmHG @ 77 °F	0.22	21	26
Vapor Pressure in psia @ 170 °F	0.14	5.2	6.8
Surface Tension in dynes/cm @ 77 °F	36	45	N/A
Solubility Parameter	15	N/A	N/A
Viscosity cps @ 77 °F	44	5.4	2.2
-30 °F	~ 20,000	263	N/A
170 °F	4.5	1.2	0.6
Biodegration (20 day)			
parts oxygen per part glycol	1.45		
% theoretical oxygen demand	86		

Alternate Energy Systems, Inc.
210 Prospect Park P.O. Box 2469
Peachtree City, GA 30269, USA

Phone 770-487-8596
Fax 770-631-4306
Toll Free 800-410-9161

E-Mail info@altenergy.com
WebSite www.altenergy.com