Case Study II

Performance of Extruder Distilled Water Coolants

Background. A **Case Study II.** A new sheet extrusion and thermoforming facility with four single screw water-cooled co-extrusion lines, was commissioned using commercially available distilled water as the barrel zone coolant. System metallurgies were similar to those previously noted.

Seven months after plant start-up every barrel cooling system was plagued with excessive corrosion and particulate metal oxide deposition in the zone cooling water passages. In addition, zone cooling water regulator valve operation was erratic and unreliable, and continuous recirculating pump seal failures resulted in leaks and interrupted production. The on-going parts replacements, the unscheduled outages, and the frequent system restorations were very costly.

An initial investigation confirmed the obvious: excessive metal corrosion was occurring throughout the cooling water systems. Deposits from two systems were analyzed and found to contain predominantly metallic oxide corrosion products (Table 2). Coolants from both lines were also analyzed and found to contain acidic pHs and significant concentrations of iron and chloride salts (Table 3). As expected, the alloyed zone barrel cooling water passages appeared to be unaffected by the corrosive environment as evidenced by the virtual absence of nickel and chromium in the coolants. Unexpectedly, constituents of some inorganic salts typically present in raw waters were found in both the system deposits and the distilled water coolants.

Table 2. Elemental Analysis of Water-Cooled Extrusion Deposits (%).

	Line 1	**Line 2**
Iron (as Fe)	71.2	78.0
Copper (as Cu)	5.9	0.0
Zinc (as Zn)	3.7	5.3
Oxygen (as O)	17.8	13.5
Silica (as Si)	1.0	1.2
Phosphorus (as P)	0.4	0.2
Sodium (as Na)	0.0	1.8

During the next few weeks of production pump and system auxiliary component replacements ceased to be the weekly tasks that they had been for the first seven months of operation. For the next eighteen months there had been zero unscheduled line shutdowns

attributed to zone heater/cooler cooling system water-related issues.

Table 3. Water-Cooled Extruder Coolant Analyses (ppm).

	Line 1	Line 2
pH	5.22	4.54
Chloride	21	3
Chromium	0	0
Iron	103	790
Nickel	0.32	0.70

Corrosion in high temperature, mixed metal, pure water systems can be difficult to control. In the presence of very small concentrations of ionic impurities, galvanic corrosion currents can be sufficient to cause very serious metallic corrosion. Both the chloride content and the acidic pH's of the coolants were sufficient enough to cause the serious corrosion observed.

To restore these systems to optimum operating condition, each extruder cooling water system was thoroughly cleaned and flushed with a proprietary organic-based chemical descaler, followed by several flushes with tap water, and concluding with at least one high-purity water flush. After each system was cleaned following this procedure, it was charged with Extrusion Performance Fluid, a water-based, all-organic corrosion and deposit inhibition coolant. Typical 'before-and-after' coolant clarity is illustrated in Figure 5.

Figure 5. Fouled extrusion system distilled water coolant (left) and one maintained with EPF (right).

-specified items. An analysis of the debris from one of the reservoir tanks is summarized in Table 1.

Results. Seven

Summary. Water-cooled extruder barrel cooling systems maintained with ***Extrusion Performance Fluids*** and periodically monitored:

- **Minimize**
- **Reduce**

For additional information regarding the cleaning, restoration and maintenance of water-cooled extruder barrel cooling water system, please contact *Chemagineering Corporation* at www.chemagineering.com.