Case Study Intro

Extrusion Performance Fluids – Crucial in Maintaining Water –Cooled Extruder Efficiencies

Peter E. Greenlimb, Ph.D., Chemagineering Corporation, Rolling Meadows, IL

Abstract. Many manufacturers of water-cooled extrusion equipment typically recommend that either distilled water or properly-treated water [1,2] be used to control barrel zone heater/cooler temperatures. While many industrial water treatment professionals treat and maintain cooling towers, chill rolls and other Utility Water Systems in extrusion plants, few, if any, have attempted to solve the corrosion, fouling and mineral deposition issues typically experienced in extruder barrel cooling systems (Process Water Systems).

This paper summarizes our experiences over the past fourteen years developing and successfully applying Extrusion Performance Fluids (EPF) as safe and effective coolants in water-cooled extrusion applications. Key documented case studies and simple extrusion maintenance procedures will be discussed which form the basis for a pending US Patent [3] on EPF and its associated technologies.

Extrusion Water Management The successful and continuous operation of water-cooled extrusion equipment has associated with it five key water management operational objectives. These objectives are virtually identical to those industrial water treatment professionals recommend for virtually all cooling water systems [4]. From an extrusion perspective they include:

- Maintaining optimum zone temperatures.
- Preventing system corrosion.
- Preventing mineral deposition and fouling.
- Eliminating unscheduled down-time.
- Extending equipment life.

Even though the majority of water-cooled extruder components are manufactured with corrosion resistant alloyed steels, the high surface temperatures encountered in zone heater/coolers and the galvanic couples existing between two or more dissimilar metals within the system contribute to potentially very serious corrosion issues. In addition, the metallic corrosion products that are formed foul the small diameter zone heater/cooler water passages, the zone flow regulating valves, and the supply/return hoses. Many water-cooled extrusion metallurgies have been tabulated by their relative cathodic or anodic behaviors in an aqueous environment [4].

Water Qualities Water quality is a vital issue in the operation of water-cooled extruders. Untreated and Conventionally Treated Raw Waters will almost always lead to unwanted mineral and/or chemical deposit accumulations in the cooling passages of zone heater/coolers. Case Study I documents this deposition problem. In addition, under-deposit corrosion can develop as a consequence of the deposit formation. Zeolite Softened Waters pose a very serious threat due to their enhanced ability to conduct galvanic corrosion currents and their inherent corrosivity.

Case Study Intro

Distilled, Deionized, Demineralized, and other Unbuffered, High Purity Waters often contribute to system corrosion and subsequent component failure. Distilled water qualities vary considerably, some of which could contain sufficient dissolved solids and be fairly conductive for galvanic corrosion currents. Some high purity water qualities are listed in Table 1.

	µmhos/cm	ppm
USP Distilled	300,000	3.5
3X Distilled	1,000,000	0.5
Demineralized	18,000,000	0.03
Theoretical	26,000,000	0.02

Table 1. Pure Water Specific Conductance's Versus Dissolved Solids Concentrations.

Water Issues In most water-cooled extruders using distilled or softened waters as the heat transfer fluid, component corrosion is the most frequently encountered water-related issue. As system corrosion continues the corrosion products that are formed foul narrow water passages, deposit on heat transfer surfaces, impede zone valve operations, and accelerate corrosion due to their physically abrasive action on softer metal surfaces such as those of brass and copper. In the pitting corrosion of mild steel it has been estimated that the volume of iron oxide corrosion products produced is approximately seventeen times the volume of the metal lost. A ⅜" diameter stainless steel zone inlet coupling plugged with corrosion and mineral deposits illustrates the severity of this issue in water-cooled extrusion equipment (Figures 1 and 2, respectively).

Extruder barrel cooling systems contain a variety of different metals and thus provide viable sites for galvanic corrosion reactions. In addition to corrosion-resistant alloyed steels and nickel alloys, copper, brass, mild steels, and cast iron pump housings, some extruder operators utilize zinc sacrificial anodes in their reservoir tanks to minimize the corrosion processes [1].

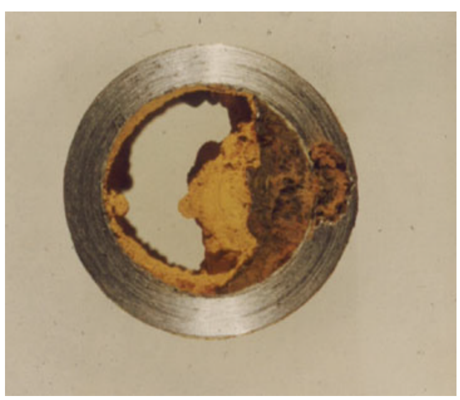

Figure 1. Iron oxide formation in the pitting corrosion of mild steel.

Case Study Intro

Figure 2. Plugged extruder ⅜ inch zone inlet coupling.

In many instances when critical extruder components fail, less corrosion resistant replacement parts are used in order to minimize downtime. Unfortunately, the more anodic nature of these parts causes them to corrode and fail at even faster rates, leading to additional system fouling, more premature part failures, and reoccurring unscheduled outages. While many alloyed steel components can be expensive, their availability in extrusion plant maintenance shops is recommended.

Some extrusion plants utilize untreated raw waters as barrel coolants. Invariably they experience frequent heater/cooler failures due to hard water mineral deposition on the heat transfer surfaces. Usually an inventory of heater/coolers is maintained in their maintenance shops to minimize downtime while repairs are made. Zone heater/cooler failures become predictable and are often routinely replaced. The costs associated with these maintenance practices becomes a predictable expense item in the extrusion department's annual operational budget.

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.