CRS REPROCESSING SERVICES

A Global Partner in Fluid Reprocessing Management

CASE STUDY

Customer: Major Aluminum rolling mill
Site: Eastern US
Items: Hot Rolling Mill using an emulsified fluid with additives

Innovative Operating Cost Reducing Filtration System for Hot Mill Applications

CHALLENGE

The primary function of the Hot Rolling Mill in the Aluminum rolling mill is to reheat the semi-finished aluminum ingots to their near melting point and then roll them under extreme pressure to thinner and longer strips of aluminum. The roll's design and pressure applied to the aluminum ingot varies from one hot rolling mill to the next. Additionally, the coolant/lubrication fluid used in the rolling process varies from one plant to the next. In this particular case, the hot rolling mill uses an emulsion that consists of water and oil that is specially mixed by their lubrication supplier. In addition, this hot rolling mill uses an additive package to receive the product quality that it desires. As with most production facilities, the lubrication used in the hot mill rolling process is very expensive. Therefore the use of an ineffective filtration system that does not remove an appreciable amount of aluminum fines and tramp oils is very costly to the operation of the plant. It is also very important that the filtration system does not remove too much of the additive (added to make the lubrication effective) as it is not economical for this facility. The current state at the hot rolling mill is to process the coolant/lubrication fluid through the vacuum flatbed filtration system. This vacuum flatbed filtration system does not remove the desired aluminum fines and tramp oils. Therefore it was decided to evaluate state of the art filtration equipment that could remove additional metal fines and tramp oils and keep the additive package present in the rolling coolant.

SOLUTION

The Aluminum Hot Rolling Mill facility began its evaluation with a Dissolved Air Flotation filtration (DAF) system to accomplish their objectives. After a six month trial period, it became apparent that this system would not deliver the desired results.

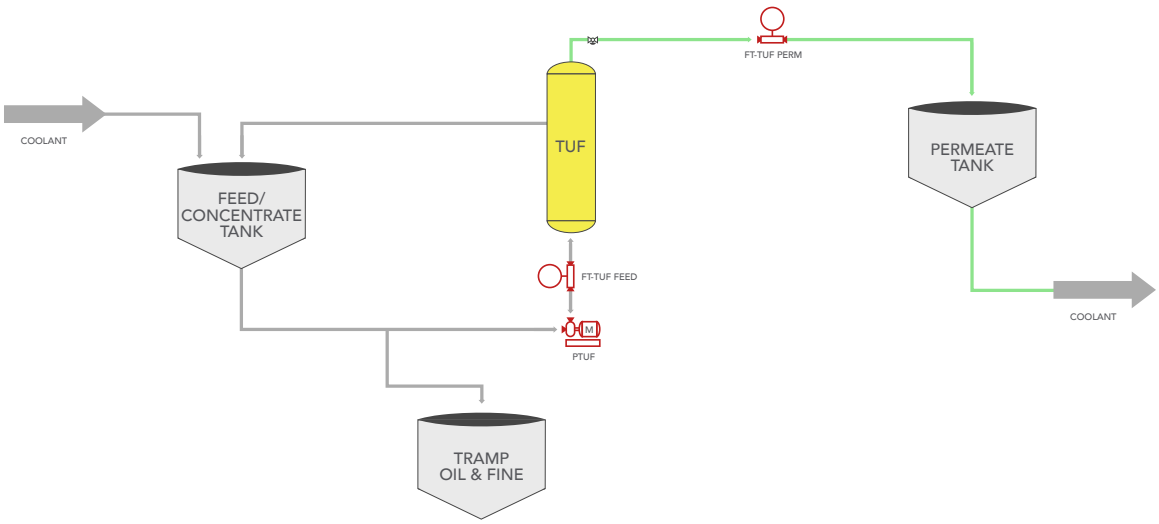
The CRS solution began with a thorough lab analysis that showed the predicted particle distribution, tramp oil removal, additive recovery and oil coolant recovery that would be realized with a full scale model. The results from this initial lab analysis convinced the hot rolling mill management team to move forward with a CRS pilot unit to verify the lab results. The CRS Tough Ultra Filtration (TUF) pilot unit is a custom process filtration system that consists of five different membranes each with a different porosity. The principle of operation of the TUF is cross flow filtration which generates both a permeate and a concentrate. CRS selected the TUF-D membrane as the most likely porosity size that would not impact the additive package or emulsified oil levels, while still removing aluminum fines and tramp oils.

The objective of the trial was:

1. Validating lab results
2. Determine the maximum flux rate thru the membrane while removing tramp oils and not stripping out the additive or emulsified oil
3. Maximum metal particulate removal in the fluid.

The feed tank of the TUF-D pilot unit system was filled from the dirty oil tank of the rolling mill. The permeate generated from the TUF-D membrane was sent to the mill for re-use, and the concentrate from the TUF-D pilot unit was sent to the feed tank, thereby re-concentrating the contaminates that the TUF demo unit is subjected to on an ongoing basis. Below is the Process Flow Diagram that was used at this location.

HOT MILL TUF PFD



CRS TUF Pilot Unit

Left: Hot Mill Active System
Right: TUF-D Permeate

The oil layer on the Hot Mill active system was consistently removed as shown in the TUF-D membrane permeate photo.

As shown in the table below, the TUF-D membrane was able to successfully reduce the dirt load and key elements from the dirty hot rolling oil beyond the current vacuum flatbed filtration system. Along with other key metal particulates, the CRS TUF-D membrane was able to reduce the aluminum particulates by **71%**, while the current system yields only a **31%** reduction. Another important parameter to highlight is that essentially no emulsified oil or additive was removed during this investigation, as shown in the oil layer measurements. The ability to segregate the tramp oils from emulsions and additives is supported by the photos shown below.

	Constellium Dirty Tank	TUF-D Permeate	TUF Removal %	Current Filtration System	Current Filtration Removal %
Physicals:					
Appearance	Medium Grey, Heavy Oil Float	Light Grey, Very Slight Oil Float			
pH	6.0	6.2		6.6	
Oil layer (%)	3.4	3.2			
Dirt Load (8u, ppm)	200	32	84%	120	40%
XRF (semi-quant):					
Sulfur, ppm	142	55	61%	141	.7%
Aluminum, ppm	988	287	71%	679	31%
Silicon, ppm	150	27	82%	109	27%
Iron, ppm	52	13	74%	17	67%
Phosphorous, ppm	26	11	56%	24	7%
Calcium, ppm	96	83	13%	62	35%
Zinc, ppm	6	5	17%	2	66%

ADDITIONAL BENEFITS

Although not part of the initial investigation, CRS treated the concentrate that was generated from the TUF–D membrane through a TUF– N membrane. The fluid processed through the TUF– N membrane produces both a permeate stream and a concentrate stream. The permeate stream is a clear liquid (see below) which reduces the overall waste that would otherwise be generated. The permeate stream produced from the TUF–N produces a high quality of waste water as outlined in the table below. This reduction in waste generated from the hot mill rolling oil significantly reduces the waste disposal cost for this hot mill.

The TUF-N concentrate stream becomes the hot mill rolling oil waste stream, which consists of metal fines and tramp oils, thereby becoming the only waste that needs to be disposed. Using the TUF– N to treat the concentrate from the TUF–D reduces the customer's disposal costs.

Left: TUF-N Permeate
Right: TUF-N Concentrate

The industrial effluent guidelines are outlined versus the TUF–N permeate's elemental measurements.

	TUF-N Permeate	Industrial Effluent Specifications
Physicals:		
Appearance	Clear/Haze	
pH	6.6	6.0-10
Oil Layer (%)	NA	
Dirt Load (8u, ppm)	10	
XRF (Semi-quant):		
Sulfur, ppm	7	
Aluminum, ppm	48	
Silicon, ppm	14	
Iron, ppm	4	
Phosphorous, ppm	2	
Calcium, ppm	57	
Zinc, ppm	2	25
Cyanide, ppm		10
Arsenic, ppm		3
Cadmium, ppm		15
Chronium, ppm		10
Copper, ppm		15
Lead, ppm		40
Mercury, ppm		2
Silver, ppm		5

RESULTS

The CRS pilot unit confirmed the initial lab results that provide the level of cleanliness by meeting the tramp oil and particulate removal requirements. The customer is achieving the following in the reprocessed fluid that is returned to the system:

- Typical hot mill oil recovery rate is **95%**+
- Improved the dirt load beyond what the current filtration system is capable of producing, thereby reducing the particulate volume in the reprocessed emulsion coolant.
- No traceable amounts of additive or emulsions being removed.
- Complete tramp oil removal during this investigation.
- Noticeable improved appearance of coolant from the dirty tank to the permeate generated from the TUF–D membrane.
- Transparent appearances of the TUF–N permeate which produced waste water quality fluid, thereby reducing the overall disposal cost.
- Lower virgin feed stock oil and additive cost added back to the system.