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METAL FINISHING WASTEWATER PRESSURE FILTER OPTIMIZATION (U)

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by S. W. Norford

Westinghouse Savannah River Company
Savannah River Site
Aiken, South Carolina 29808

Other Authors:

G. A. Diener
(WSRC)
H. L. Martin
(WSRC)

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METAL FINISHING WASTEWATER PRESSURE FILTER OPTIMIZATION

Stephen W. Norford, Glenn A. Diener, and Hollis L. Martin
Westinghouse Savannah River Company
PO Box 616, Bldg. 730-M
Aiken, SC 29808
(803) 725-1375/ FAX (803) 725-4095

Introduction

The 300-M Area Liquid Effluent Treatment Facility (LETF) of the Savannah River Site (SRS) is an end-of-pipe industrial wastewater treatment facility, that uses precipitation and filtration which is the EPA Best Available Technology economically achievable for a Metal Finishing and Aluminum Form Industries. The LETF consists of three close-coupled treatment facilities: the Dilute Effluent Treatment Facility (DETF), which uses wastewater equalization, physical/chemical precipitation, flocculation, and filtration; the Chemical Treatment Facility (CTF), which slurries the filter cake generated from the DETF and pumps it to interim-status RCRA storage tanks; and the Interim Treatment/Storage Facility (IT/SF) which stores the waste from the CTF until the waste is stabilized/solidified for permanent disposal. 85% of the stored waste is from past nickel plating and aluminum canning of depleted uranium targets for the SRS nuclear reactors.

Federal Facilities Compliance Agreement (FFCA), between the Department of Energy (DOE) and the Environmental Protection Agency (EPA), mandates that this F006 mixed (hazardous and radioactive) waste be treated (stabilized) for disposal and that the IT/SF be clean closed. Since startup of the LETF in 1985, more than 1,000,000 gallons of wastewater slurry have transferred to the IT/FS tanks. The uranium and heavy metal precipitate at pH12, and the slurry has separated into sludge and supernate. The supernate is being decanted from the IT/SF and processed with production building wastewater by the DETF prior to stabilizing the sludge. Waste minimization and filtration efficiency are key to cost effective treatment of the supernate, because the waste filter cake generated is returned to the IT/SF. The DETF has been successfully optimized to achieve maximum efficiency and to minimize waste generation.

As shown in Figure 1, dilute wastewaters from three M-Area production buildings and two support laboratories are discharged through a process sewer to the DETF collection sump where it is pumped to one of two equalization tanks. As one equalization tank receives wastewater, the contents of the other are processed through the DETF. Supernate is added while the equalization tank is filling. Sulfuric acid is added adjusting to pH 2.3 to dissolve all metals and to volatilize any residual carbonate. Aluminum sulfate is added as needed to precipitate excess phosphate. The wastewater is adjusted with caustic to pH 8.0 - 8.5, the optimum pH for metal phosphate removal.

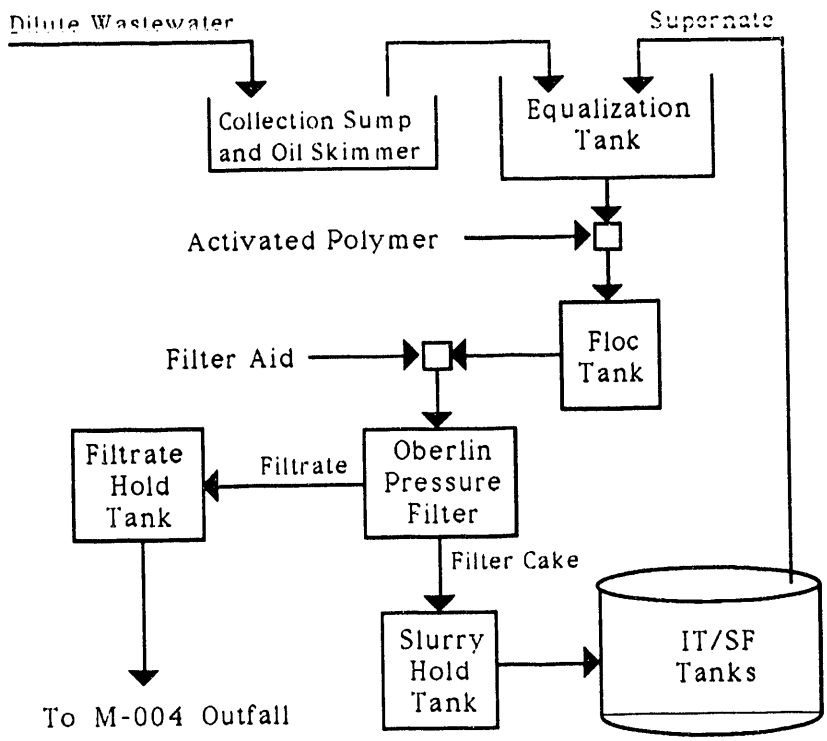

Figure 1. DETF Process Flow Diagram

As the wastewater is pumped to a flocculation tank, cationic polymer is added at an in-line static mixer via a flow ratio controlled metering pump with a water activation-mixing chamber. From the flocculation tank, the wastewater is pumped at 20-25 gpm to two Oberlin® pressure filters operating in parallel. Upstream of each filter, the wastewater passes through an in-line mixer where a perlite filter aid solution is added by flow ratio control to enhance filtration. The weight ratio of filter aid to total suspended solids (TSS) in the wastewater is controlled by adjusting the volume of water per bag added to the filter aid mix tank.

The filtrate is collected in hold tanks. After analysis confirms compliance with National Pollutant Discharge Elimination System (NPDES) permit limits, the filtrate is discharged to a small creek . The air dried filter cake is collected in 55 gallon drums that are emptied into the CTF slurry tank and pumped to an IT/SF tank. The filter cake from current production has lower heavy metal concentration. Disposal cost will be less, so it is stored in a separate IT/SF tank.

Polymer Optimization

The DETF began processing stored waste supernate at low 4 % vol concentrations. The treated wastewater then contained 600 mg/L TSS, and 25 ppm of Praestol®K144L cationic polymer was used to flocculate the metal phosphate particles. After control of the polymer addition was demonstrated, the grade of filter aid was changed to match the particle size of the floc which increased filtration efficiency. However, as the supernate concentration was increased to 10% vol (2100 mg/l TSS) to reduce the volume of stored waste at a faster rate, the K144L became ineffective. The floc strength decreased becoming shear sensitive and difficult to control. The air-operated double diaphragm

pumps that feed wastewater to the pressure filters sheared the floc to the extent that the filter media quickly blinded.

Laboratory evaluation revealed that the Praestol K290FL, a high charged-high molecular weight cationic polymer, would increase the filtration capacity by 15X. Full scale demonstration in the DETF verified that the polymer is effective at the higher supernate concentrations, and flocculation is now much easier to control. The K290FL has been used for 10 months and has reduced the generation of waste filter media 50%.

Filter Aid Quality

Filter aid enhances filtration by trapping solids and providing channels for the liquid to flow. Selecting a filter aid that achieved that minimum waste filter cake and media generation and maximum filtration rates was the key to cost reduction. The lower the weight ratio of filter aid to TSS in the wastewater, the less sludge (originally 75% filter aid) returned to the storage tanks for future disposal.

The DETF uses perlite filter aid which is a volcanic ore (sodium potassium aluminum silicate). When heated the ore expands nearly twenty (20) times its original volume breaking into fine particles that look like broken egg shells under the microscope. These are separated into grades of different particle size.

At the beginning of supernate treatment, the DETF was using a specialty grade of high quality filter aid. In the summer of 1990, however, the manufacturer began using a lower grade ore and made plant modifications to increase capacity. The product quality diminished. The product contained excess fines which prematurely blinded the media, and contained excess floats which do not aid in pressure filtration. DETF filter capacity decreased and waste generation increased, and treatment of waste supernate was stopped.

Extensive evaluation of filter aids that best matched the DETF wastewater began. 7.5-10.5 micron median particle size with <1% wt of <1 micron particle, <4% wt of <3 micron particles, and <6% vol floats is required. All known perlite filter aids that may qualify were evaluated using the SediGraph. Because it is most important that the filter aid contain no fines (which are difficult to accurately measure), 0.5 gram of the filter aid was added to 500 ml of distilled water and the time for 400 ml to gravity drain through a 3 micron Nuclepore® membrane in a 90 mm Stir Cell was measured. The filtrate turbidity was also measured, and neutral pH of the filtrate was verified. The average results of the evaluation are outlined in Table 1.

Table 1. Filter Aid Quality Analyses

	Accept Limit	Orig. Grade	Mfr. #1	Mfr #2	Renaissance TechFlo 2000X
pH	6.0 - 8.0	6.3	6.1	6.6	6.4
Turbidity, NTU	0.3	0.3	0.4	0.83	0.15
Floats, %vol	<6	16	26	8	3
Drain Time, Seconds	<140	128	152	196	131
Fines,%wt <1 micron	< 1	<1	<1	2.2	<0.1

Thus far, Renaissance is the only company that has demonstrated the ability to provide a consistent high quality filter aid (TechFlo 2000X) that best matches the DETF treated wastewater. With the 2000X, the DETF has reduced waste filter cake generation by 15%

versus the original filter aid. The evaluation of another grade from manufacturer #2 is in progress.

Cleanable Filter Belt Evaluation

The DETF used Tyvek® T980 disposable filter media with 0.37 micron nominal particle removal rating. Filtrate quality using the Tyvek® was excellent, however, the F006 mixed waste filter paper disposal cost was an increasing concern. Two (2) rolls of Tyvek® T980 were generated each 36,000 gallon wastewater batch with a disposal cost of $500/roll with over 250 batches remaining before supernate treatment is completed.

With the very few submicron particles in the TechFlo® 2000X filter aid, use of a cleanable filter belt appeared technically feasible. Evaluation of filter belts began on the Oberlin® pressure filters in early October 1992. Three (3) different weave polypropylene belt fabrics (1, 2, and 5 scfm/ft^2 Frazier airflow) were initially used. Each belt provided filtrate quality and filter performance equal to that of the Tyvek® media. Belt life for the Micronics WWPP807 belt (5 scfm/ft^2), however, was significantly longer. This belt was used for approximately ten (10) wastewater batches before becoming plugged with filter aid, while the other belts averaged four (4) batches before becoming plugged. Microscopic analysis revealed that submicron filter aid particles (aluminum and silica) had plugged the belts, confirming that filter belt life is dependent on filter aid quality. The DETF now routinely uses the WWPP807 belt with cost savings of $200,000 annually from reduced waste filter media generation.

Conclusion

Waste generated from filtration of metal finishing wastewater was minimized by (1) control of floc size through selection of polymer and optimization of dosage, (2) filter aid grade selection to match the floc size, (3) monitoring the filter aid quality to ensure uniform particle size distribution and no fines (<1%wt of < 1 micron and <4%wt of < 3 micron particles). With high quality perlite filter aid and proper selection of the filter belt fabric, a 7X reduction of waste filter media was achieved by conversion to cleanable belts (the generation of used belts is minuscule compared to the generation of used filter paper media). The generation of filter cake was also reduced 40%. Filtrate quality remained excellent.

Present worth cost savings of these F006 mixed waste reductions total $1,900,000. More optimization is planned in the future, so this saving will be increasing as supernate treatment continues.

Acknowledgements

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