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Remediation**

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Tank 12 Bulk Oxalic Acid Cleaning Flowsheet Strategy



**SCDHEC Briefing
April 2013**

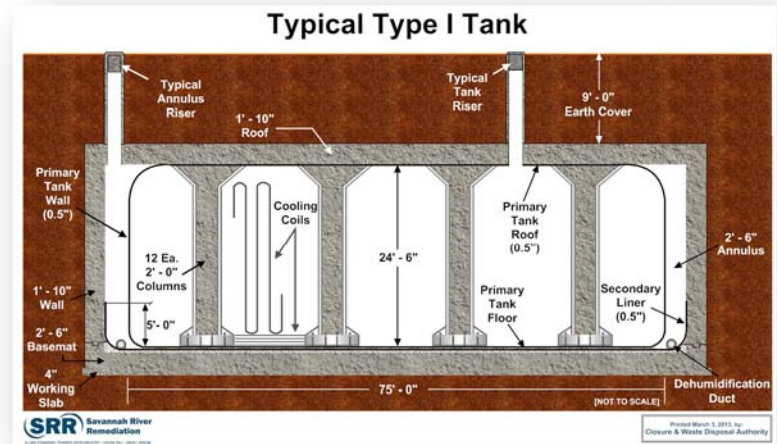
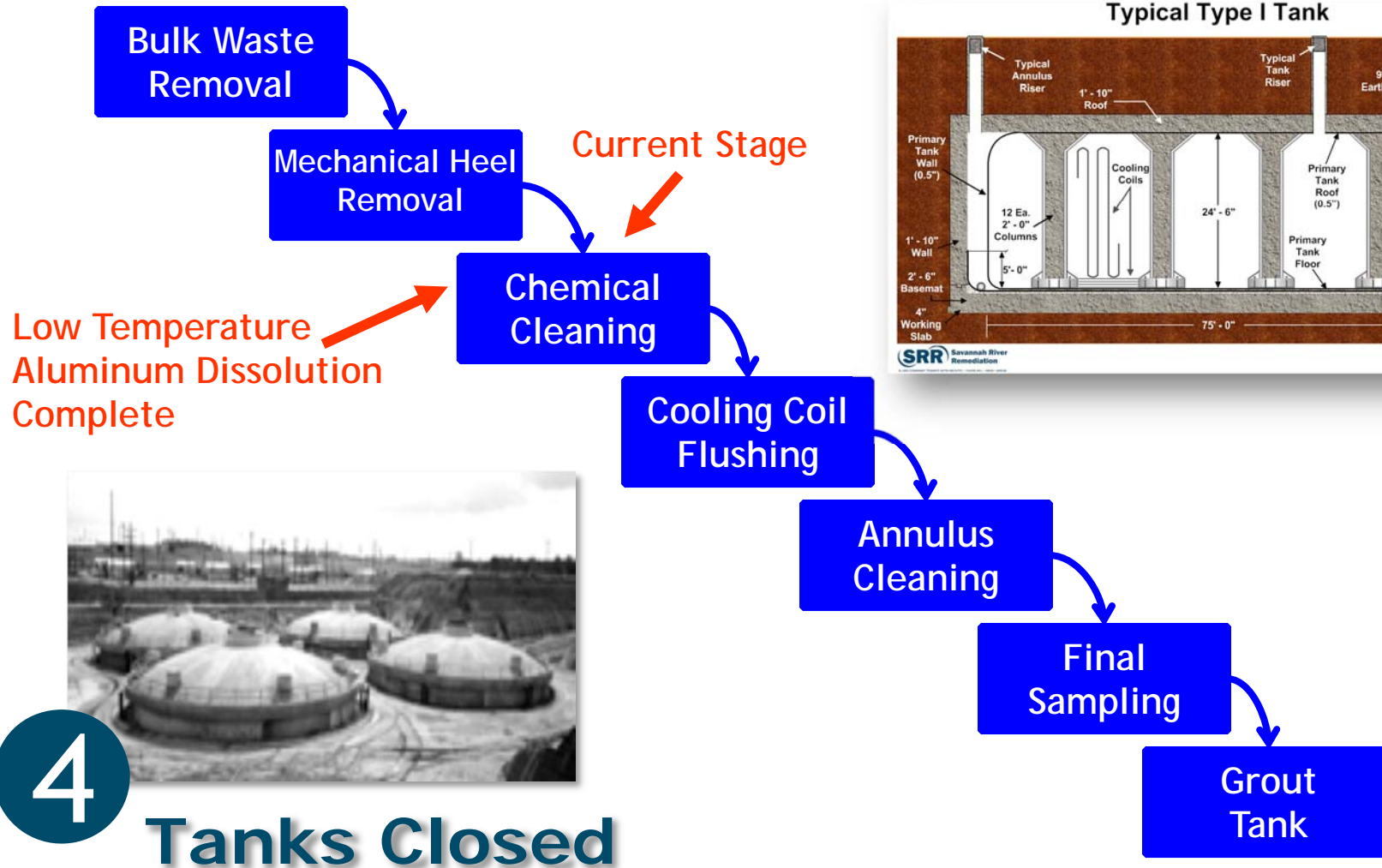
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- Tank closure sequence
- Tank 12 waste removal summary to date
- Bulk Oxalic Acid Chemical Cleaning (BOAC) flowsheet overview
- Chemical cleaning experience
- Implementation of Tank 12 chemical cleaning flowsheet

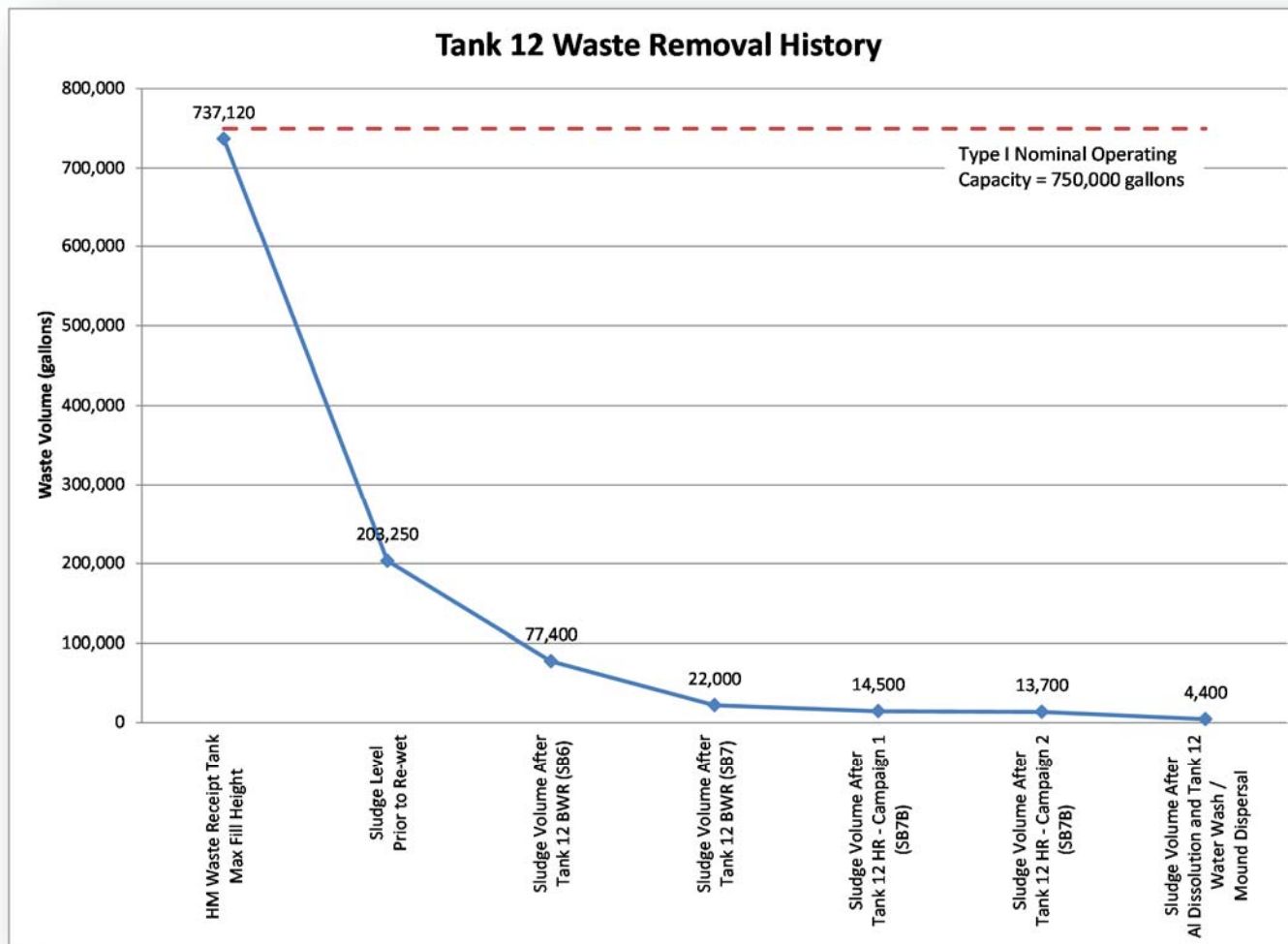
Closure Sequence

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Tank 12 Waste Removal History

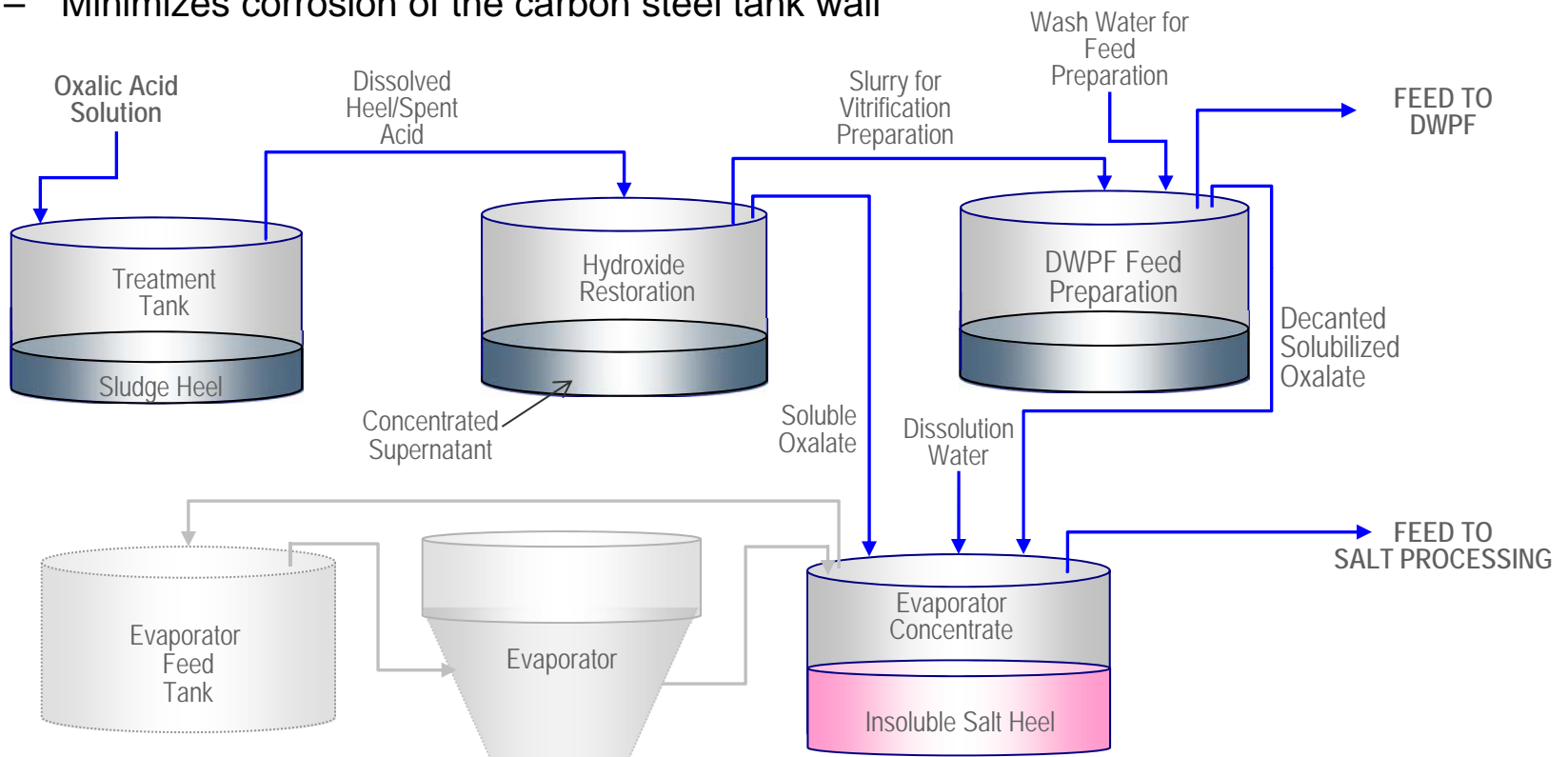
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Bulk Oxalic Acid Chemical Cleaning

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- Chemical cleaning intended to remove residual sludge following bulk waste removal and mechanical cleaning, when necessary
- Use oxalic acid to clean waste tanks and nominally remove residuals
 - Used multiple times since 1980's
 - Minimizes corrosion of the carbon steel tank wall



- Developed based upon experience with chemical cleaning and detailed experimental program
 - Optimize sludge removal, minimize safety hazards, and minimize corrosion
- Experience from chemical cleaning of Tanks 5 & 6
 - Maximize contact of residuals with oxalic acid
 - Sludge depth and chemical constituents
 - Insoluble particulate mobilization
 - Provide adequate mixing
 - Control pH to prevent oxalate production
 - Pre-wash treatment tank to target sodium oxalate solubility

Tank 12 Flowsheet

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BOA Baseline		Tank 12	
Attribute	Basis	Attribute	Implementation/Status
Pre-wash sludge heel	Pre-wash to a target based on solubility of sodium oxalate, i.e. $[Na^+] = 0.5 \text{ M}$	Pre-wash heel to $[Na^+] = 0.5 \text{ M}$	Complete
4 SLP's or 3 SMP's at maximum speed	Number of slurry pumps that supports coverage of the entire tank bottom to: <ul style="list-style-type: none"> Maximize OA-sludge contact Mobilize insoluble particles Allow focused indexing on mounds 	4 SLP's at maximum speed	4 slurry pumps running in indexing mode at maximum speed when tank levels allow
Disperse mounds during pre-wash	Distribution of the mounds maximizes OA-sludge contact	Disperse mounds during pre-wash	Significant mound reduction during low temperature aluminum dissolution (LTAD) Strike 2 to include focused indexing and longer pump runs focused on expected mounds
Planning basis of 3 OA strikes and OA spray wash	<ul style="list-style-type: none"> Tank 16, 5, & 6 chemical cleaning experience OA spray wash dissolves sludge material on the vertical surfaces of the tank, not submerged during the strikes 	3 strikes	<ul style="list-style-type: none"> 3 OA strikes
Maximum Volume ratio of 20:1 OA to Sludge	<ul style="list-style-type: none"> Limits based on envelope of experimentation Fill height determined by starting solids concentration Tank level limitations may restrict volume of acid potentially affecting efficiency 	Maximum Volume ratio of 20:1 OA to Sludge	<ul style="list-style-type: none"> Tank level will restrict first strike to nominally 15:1 ratio of OA/sludge Second and third strike will be at 20:1 ratios.

Tank 12 Flowsheet

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BOA Baseline		Tank 12	
Attribute	Basis	Attribute	Implementation/Status
Maximum OA concentration of 8 wt% OA	<ul style="list-style-type: none"> Limits based on envelope of experimentation 2-4 wt% OA based on solubility limit of oxalate 	8 wt% diluted to 4 wt%	To support mixing in the 2 nd and 3 rd strikes, the OA will be diluted to <4 wt%
<ul style="list-style-type: none"> Processing temperature 75°C maximum Normal operations ≤60°C 	Experience indicates higher temperature results in more effective dissolution Maintain temperature within envelope of experimentation: <ul style="list-style-type: none"> All PUREX testing has been completed at ≤ 75°C HM testing completed at ≤ 75°C with no agitation and ≤ 60°C with agitation 	Add OA at elevated temperature (55 - 65°C)	<ul style="list-style-type: none"> Higher temperature will result in a treatment tank temperature of ~50 - 55°C Slurry pump and transfer restrictions limit tank temperature to 60°C
Maintain pH<2	Experience indicates increased pH (>2) reduces the solubility of metals, therefore precipitating oxalates	Maintain pH <2	Minimize potential for oxalate precipitation also through timely transfers
Pump down between strikes to a minimum level	Reducing the heel volume: <ul style="list-style-type: none"> Increases the fresh OA-sludge contact on subsequent strikes Maintains a lower pH reducing precipitation of oxalates Removes spent acid from the treatment tank 	<ul style="list-style-type: none"> Pump down to 11" between strikes Pump down to 3" after Strike 2 & 3 	<ul style="list-style-type: none"> Optimizes reduction of heel volume between strikes accommodating current STP configuration while minimizing contamination and high radiation exposure risk Dewatering pump will be used after Strikes 2 & 3

Tank 12 Flowsheet Protocol Three Acid Strikes

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Strike	Purpose	Chemical Additions	Mixing	Transfer Protocol & Monitoring
1	<ul style="list-style-type: none"> Target previously suspended, loose sludge on floor Represents ~65% of sludge based upon inspections completed 	<ul style="list-style-type: none"> Add 65 kgal of 8 wt% OA to Tank 12 at 60°C Dilute with 65 kgal of well water to a 4 wt% OA concentration 	<ul style="list-style-type: none"> Operate 4 SLPs in rotation mode for 2-3 days as dictated by monitored pH 	<ul style="list-style-type: none"> Temperature Obtain periodic dip samples to confirm pH Video inspection after transfer out
2	<ul style="list-style-type: none"> Target acid/sludge contact with mounds under valve house 	<ul style="list-style-type: none"> Add 16 kgal of 8 wt% OA to Tank 12 at 60°C Dilute with 50 kgal of well water to an OA concentration of 2 - 4 wt% 	<ul style="list-style-type: none"> Operate 4 SLPs 6-8 days as dictated by monitored pH 	<ul style="list-style-type: none"> Temperature Obtain periodic dip samples to confirm pH Video inspection after transfer out Add IW/WW to neutralize solution
3	<ul style="list-style-type: none"> Target remaining mounds/residual solids as identified in Strike 2 video inspection 	<ul style="list-style-type: none"> Add 14 kgal of 8 wt% OA added to Tk12 at 60°C Dilute with 80 kgal of well water to OA concentration of 1.5 - 4 wt% 	<ul style="list-style-type: none"> Operate SLPs for 3 days Mixing strategy will be tailored based on the Strike 2 video inspection 	<ul style="list-style-type: none"> Temperature Obtain periodic dip samples to confirm pH Video inspection after transfer out Neutralize solution Volumetric examination of tank wall

- Tank 12 is a Type I tank that has entered the chemical cleaning phase in the closure sequence
- Equipment modifications and new safety basis controls established to address potential hazards
- The Tank 12 chemical cleaning flowsheet developed based upon experience with chemical cleaning and a detailed experimental program
 - Three strikes with oxalic acid maximizing OA-sludge interactions, adequate mixing, and pH control
 - Sampling and monitoring program in place to ensure operational efficiency and safety envelope maintained