U. S. Army Corps of Engineers
Metals Precipitation
Checklist

Installation Name	___________________________
Site Name / I.D.	___________________________
Evaluation Team	___________________________
Site Visit Date	___________________________

This checklist is designed to facilitate the performance evaluation of a chemical precipitation treatment unit used to remove metals from a water stream. It is divided into the following sections:

1) Evaluation team composition
2) Typical treatment objectives
3) References
4) Data collection requirements
5) Performance analysis calculations
6) Evaluation of operations and maintenance
7) Typical performance problems
8) Alternatives for possible cost savings
9) Supplemental notes and data.

The checklist provides suggestions for information gathering, and space has been allowed to record data and notes from the site visit. Supplementary notes, if required, should be numbered to correspond to the appropriate checklist sections.

1) Evaluation Team Composition

The following disciplines should be included in the evaluation team for the metals precipitation treatment system.

- Process Engineer (site visit, treatment system evaluation)
- Chemist (treatment chemistry)
- Cost Engineer (cost of alternatives)

2) Typical Treatment Objectives

Metals precipitation is typically used to remove dissolved metals (e.g., cadmium, chromium, copper, lead, nickel, and zinc) from wastewater or groundwater. The dissolved metals are converted to insoluble salts and removed from the water stream as sludge solids.

Verify that the treatment objectives established when the heavy metals treatment system was designed and installed are clear and still valid.

Operation and maintenance costs for metals precipitation, especially the cost of sludge dewatering and disposal, can require a significant financial commitment over the long term. Therefore, efforts should be made to implement actions that will minimize these costs.

3) References

Coordinate this checklist with the Process Instrumentation and Control System, Liquid Piping Systems, Chemical Feed and Storage Systems, and Solids Handling checklists. The following reference may also be helpful:

CEGS 11220 [1]: Precipitation, Coagulation, Flocculation Water Treatment

Note the existence of any pertinent operations and maintenance manuals.

4) Data Collection Requirements

a) Record the nameplate information from each piece of mechanical equipment (e.g., pumps, mixers) for future reference.

b) Sketch the process flow diagram (PFD), including valves and instrument locations, on the back of this sheet or on a separate sheet.

4.1) General Treatment Process

The following information is needed to assess the performance of the treatment process. Record the appropriate units with each value.

a) Treatment Requirements—Target metals which require removal prior to discharge:

(Note that there may be an issue here of whether "total" or "dissolved" metals concentrations are required. The regulators may want both.)

Metal Contaminant (e.g., chrome, lead)	Influent Conc. (mg/L or mg/L)	Measured Eff. Conc. (mg/L or mg/L)	Required Eff. Conc. (mg/L or mg/L)

b) Process Data: Treatment plant flow rate: _____ gpm

Water temperature: _____ degrees C.

Influent pH ______ Effluent pH ______

Influent Alkalinity ______ mg/L Effluent Alkalinity ______ mg/L

c) Is any portion of the flow being recirculated? Where and why is this being done?
(Note: Show the recirculation stream on the PFD)

4.2) Chrome Reduction Process (If Applicable)

a) Is the chromate waste stream treated in a continuous flow process or in batches? __________

b) Volume of chrome waste treated _______ gal/day or gal/batch

c) Chemicals added for chromate reduction:

Chemicals Used for	Dosage (mg/L) *	Point of Addition
pH Adjustment (e.g., lime, caustic, acids)		
Reduction (Redox) Chemical Used (e.g., sulfur dioxide, sodium bisulfite or metabisulfite)		

* Note: dosage is mg of chemical per liter of treated water

4.3) Chemical Addition Processes

a) Chemicals added:

Chemicals Used for	Dosage (mg/L)	Point of Location
pH Adjustment (e.g., lime, caustic, acid)		
Coagulant Used (e.g., alum, ferric chloride or sulfate, polyelectrolytes)		
Flocculant (Coagulant Aid) Used (e.g., synthetic or natural organic)		

b) Are periodic jar tests being conducted to ensure optimal chemical dosages are being applied? Can any of the chemical reagent dosages be reduced without reducing treatment efficiency?

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c) Have alternative treatment chemicals been periodically evaluated for comparison with the existing process performance?

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d) Briefly describe coagulant and flocculant feed systems. Check to ensure that the shelf life of reagents are not exceeded. Verify that the feed system's calibration is checked and maintained. Check to ensure that the polymer delivery system is working efficiently.

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(Note: Experience has shown that polymer feeds operate better under flooded suction conditions rather than static lift. Flooded suction conditions prevent air entrainment thereby reducing or eliminating the potential for polymer caking.)

e) Briefly describe the clarifier sludge appearance. Bulky, fluffy, or gelatinous looking sludge may indicate improper use of chemical reagents.

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4.4) Clarification Process

a) Record the clarifier dimensions with appropriate units: (i.e., diameter, or length and width)

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b) Total suspended solids (TSS) concentration in clarifier effluent = ________ mg/L.

c) Solids concentration in the settled sludge from clarifier underflow = ________ mg/L.

d) Have the operators established an optimum sludge blanket level in the clarifier?

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4.5) Sludge Handling

a) How is the settled sludge from the clarifier dewatered and disposed? Have dewatering and disposal alternatives been investigated?

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5) Performance Analysis Calculations

a) Are the mixing rates the same as those in the design specifications? Perform mixing calculations to see if the mixing energy can be reduced and still meet the treatment requirements.

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b) Calculate the actual surface overflow rate (gal/day/ft^2) for the clarifier and compare it to the manufacturer's specifications.

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(Note: For metallic sludges, overflow rates should typically range from 360 to 720 gpd/ft^2 and should not exceed 1000 gpd/ft^2)

6) Evaluation of Operations and Maintenance

a) Verify that the ancillary equipment are maintained per manufacturers recommendations.

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b) Check all process tanks for corrosion, punctures, or excessive wear. Note any deficiencies.

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c) Check mixers for corrosion or excessive wear. Check mixing speeds in coagulation and flocculation units. Note any deficiencies or concerns below.

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d) Verify that instruments, controls and alarms are working. Are there provisions to notify an operator of malfunctions when the unit is unattended?

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e) Verify that the effluent is being sampled and analyzed in accordance with the sampling and analysis plan designed to assess the performance of the unit. Determine if any additional monitoring is needed to properly evaluate the operating conditions.

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7) Typical Performance Problems

a) If the treatment is located outside, are there provisions to drain the water lines and/or sumps when the process is shut down? Inspect the piping system to verify there is adequate insulation to prevent rupture of lines due to freezing.

b) Are there reports or indications of floating sludge in the clarifier, or of sludge carry-over to subsequent treatment units? If yes, explain.

c) Has the operator noted any problems with plugging of the clarifier? Note any deficiencies.

d) If the metals are being precipitated as sulfides, are the operators trained and adequate precautions being taken to prevent the formation and release of toxic hydrogen sulfide gas (H_2S)?

8) Alternatives for Possible Cost Savings.

The metals present in the water stream or their concentrations may have changed to the extent that other alternatives are more cost effective. Consider the following:

a) Determine if the metals precipitation treatment is still necessary, or whether influent concentrations have decreased to the point that the operation can be terminated? Can the unit be easily bypassed if this treatment is no longer needed?

b) Are more cost effective treatment alternatives available which will meet the present treatment requirements?

9) Supplemental Notes and Data

There are _______ pages of supplemental notes and data attached to this checklist.

[1] CEGS: USACE Guide Specifications for Construction, available at www.usace.army.mil/inet/usace-docs/