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WaterCare White Paper: Water Reuse Characterization

A Review of Wastewater Characteristics for Water Reuse/Recycling After Chemical and Equipment Processing

Mark ANDRUS
Business Manager, COVENTYA WaterCare
m.andrus@coventya.com

Abstract

Wastewater treatment costs are directly related to the level of water quality required to meet regulatory compliance. In addition to meeting compliance, wastewater treatment programs attempt to optimize efficiency. Improving treatment efficiency can be done by reducing the water volume treated and the sludge volume produced, reducing manpower, or by creating an effluent quality suitable for water re-use. This paper reviews wastewater treatment water quality and the affects reusing wastewater can have upon a manufacturing facility.

Background

As the cost of wastewater treatment increases, both from sludge and effluent quality perspectives, another aspect of wastewater treatment is now being reviewed closely by industries in their efforts to streamline costs. This area is the reuse of wastewater for process applications.

The following benefits can be gained by reusing discharge effluent:

- Reduced surcharges for sewer utility payments.
- Reduced water surcharges for make-up utility payments.

The reuse of wastewater from a metal hydroxide based precipitation program can be established for a number of applications. The degree of required water purity is the determining factor in establishing a reuse water program. The following degrees (or combinations of) water reuse purity can be engineered for reusing industrial wastewater:

- **Reuse "as-is," that is, a holding tank after the clarifier, or sand filter, is utilized to store discharge effluent for rerouting to industrial process.**

- **Reuse water treated with activated charcoal to remove organic contaminants.**

- **Reuse water treated for the removal of dissolved solids. This can be accomplished by either membrane filtration or ion exchange.**

Let's take a look at each of the above degrees of water purity, what is required to gain this level of water purity, and how each specific application can assist in industrial applications.

INDUSTRIAL REUSE WATER APPLICATIONS

REUSE WATER "AS-IS"

The ability to utilize clarifier discharge water in process applications, versus routing this water to the discharge sewer, has an appeal to almost everyone. This method of reuse is the least expensive, since minimal capital equipment investment is required.

Reuse water "as-is" characteristics

The water discharged from a metal hydroxide based treatment program generally has the following characteristics:

- High dissolved solids content (usually in excess of 1000 mmhos of conductivity).
- Excessive chloride content (usually in excess of 100 ppm).
- Excessive sulfate content (usually in excess of 100 ppm).
- Elevated alkalinity level (if the discharge is controlled at 9 to 10 pH units) the alkalinity level is usually above 300 ppm as Total 'M' alkalinity.
- Due to the available organic contaminants and the presence of iron (as total iron or soluble) the potential for bacterial, yeast and mold, and algae growth is high.

Reuse water "as-is" applications

Despite the drawbacks of the effects of the characteristics of "as-is" reuse water; the following applications can utilize this water source.

- Acid and caustic cleaner make-up tanks.
- Non-critical pretreatment rinse waters.

Chemical treatment of "as-is" reuse water

To minimize the effects created by the characteristics of "as-is" reuse water, chemical treatments can be applied to make this water source more compatible with facility water applications such as:

- Cooling water applications (heat exchange, and scrubber systems).

The following chemical treatment additives can be incorporated into a re-use water program:

Treatment	Function
Corrosion inhibitors	- minimize the effect of elevated chlorides and sulfates
Deposit inhibitors	- minimize the effect of elevated alkalinity and scale formation
Biocides	- control bacteria, yeast and mold, and algae growth

INDUSTRIAL REUSE WATER APPLICATIONS-

REUSE WATER WITH ACTIVATED CARBON TREATMENT

Reuse water treated with activated carbon will remove organics as they are adsorbed by the carbon particles. Advanced carbon treatment technology also is available to absorb other ions, such as cations of a metallic nature.

Reuse water treated with activated carbon characteristics

Effluent treated with activated carbon generally has the following characteristics:

- High dissolved solids content (usually in excess of 1,000 mmhos of conductivity).
- Excessive chloride content (usually in excess of 100 ppm).
- Excessive sulfate content (usually in excess of 100 ppm).
- Elevated alkalinity level (if the discharge is controlled at 9 to 10 pH units) the alkalinity level is usually above 300 ppm as total M alkalinity,

Activated carbon treated reuse water applications

The effects of elevated solids [TDS] is still present in carbon treated water, however, the organic contamination is minimized. This upgrade in water quality provides for use in the following applications provided that the TDS is evaluated for corrosion and deposition potential:

- Acid and caustic cleaner make-up tanks
- Non-critical pretreatment rinse waters
- Phosphating applications

Chemical treatment of activated carbon treated reuse water

The following chemical treatments can be incorporated into a re-use water program utilizing activated carbon:

Treatment	**Function**
Corrosion inhibitors	- minimize the effect of elevated chlorides and sulfates
Deposit inhibitors	- minimize the effect of elevated alkalinity
Dispersants	- carbon column cleaning from solids agglomeration

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INDUSTRIAL REUSE WATER APPLICATIONS

REUSE WATER WITH MEMBRANE AND/OR ION EXCHANGE TREATMENT

The ultimate step in reuse water treatment is to reduce all organic contamination, as well as eliminate all undesirable solids within this water source. Membrane technology (micro/nano/ultra/reverse osmosis) and ion exchange treatment schemes can accomplish this. Depending upon the degree of treatment, through membrane and ion exchange, reuse water can be converted into an ultra pure state. Through these steps, literally any make-up water source can be optimized within an industrial facility.

Reuse water flexibility with membrane and ion exchange treatment

- Water solids content adjusted to meet the application requirements.
- Cleaner make-up applications can significantly reduce cleaner chemical volume requirements (due to the lack of hardness, metallic salts, and oil & grease, the cleaners will last longer).
- Industrial process applications for critical rinses and process electrolytic make-up water.
- Industrial utility applications from rectifier cooling, process heat change, scrubber make-up, and boiler feed water make-up.

Chemical treatment of reuse water with membrane and/or ion exchange treatment

Despite the ultra pure, or desired degree of pure water quality, corrosion due to the low solids of these waters is common due to the lack of ions available for surface passivation. To combat this condition the following treatments can be incorporated into an industrial reuse water program using low solids water for final rinsing or cooling water applications:

Treatment	**Function**
Passivation for "final" rinsed metal parts [non-plated parts]	- Phosphate and phosphonate based inhibitors - Film forming inhibitors (i.e. tolytriazole, molybdate)
Cooling water treatments	- Organic phosphates and copolymers - Integrated multi-component treatments
Biocides	- Control R. O. membrane and ion exchange surface fouling from bacterial contamination
Dispersants	- R.O. membrane and ion exchange column fouling from solids agglomeration
Resin cleaners	- Ion exchange resin cleaners to remove inorganic contaminants and increase resin exchange capacity

See the 4 listed diagrams for schematics on water reuse.

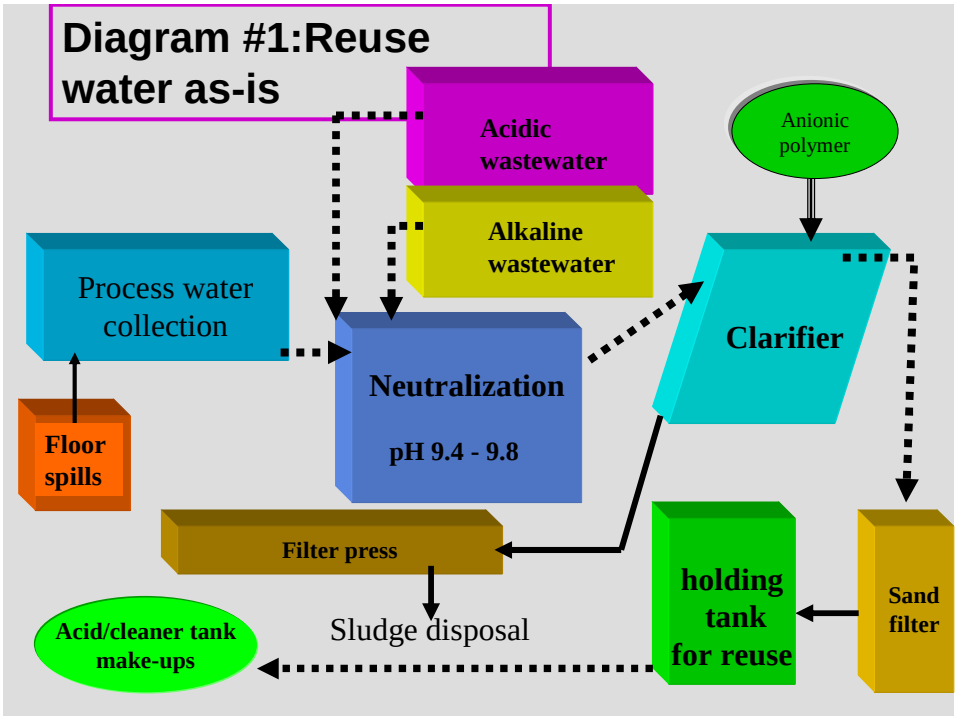


Diagram #1:Reuse water as-is
Acidic wastewater
Alkaline wastewater
Anionic polymer
Process water collection
Neutralization
pH 9.4 - 9.8
Clarifier
Floor spills
Filter press
holding tank for reuse
Sand filter
Acid/cleaner tank make-ups
Sludge disposal

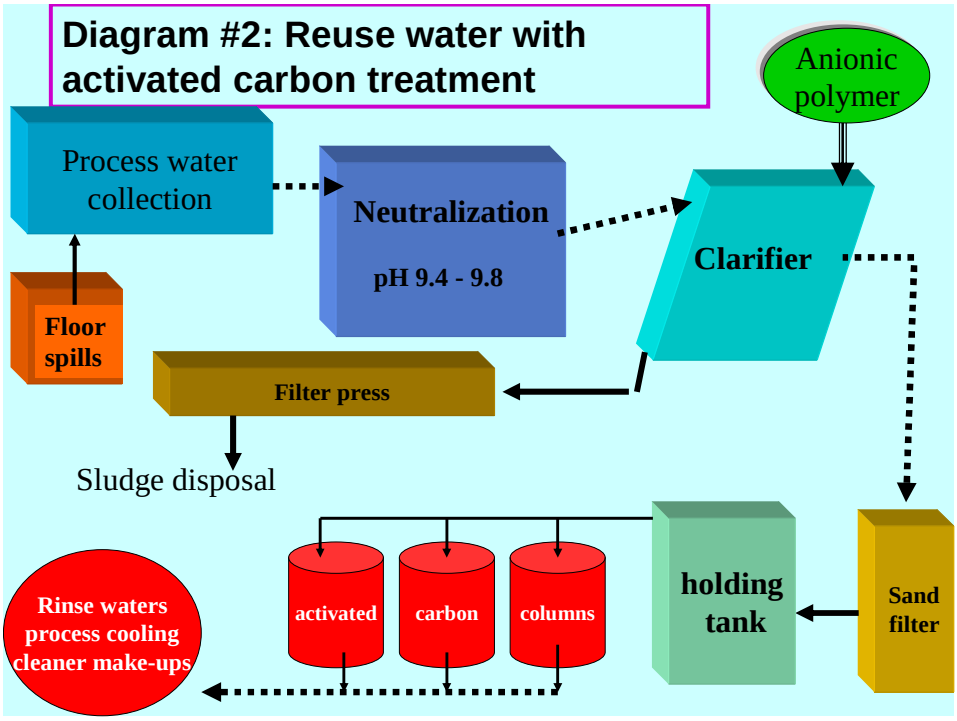
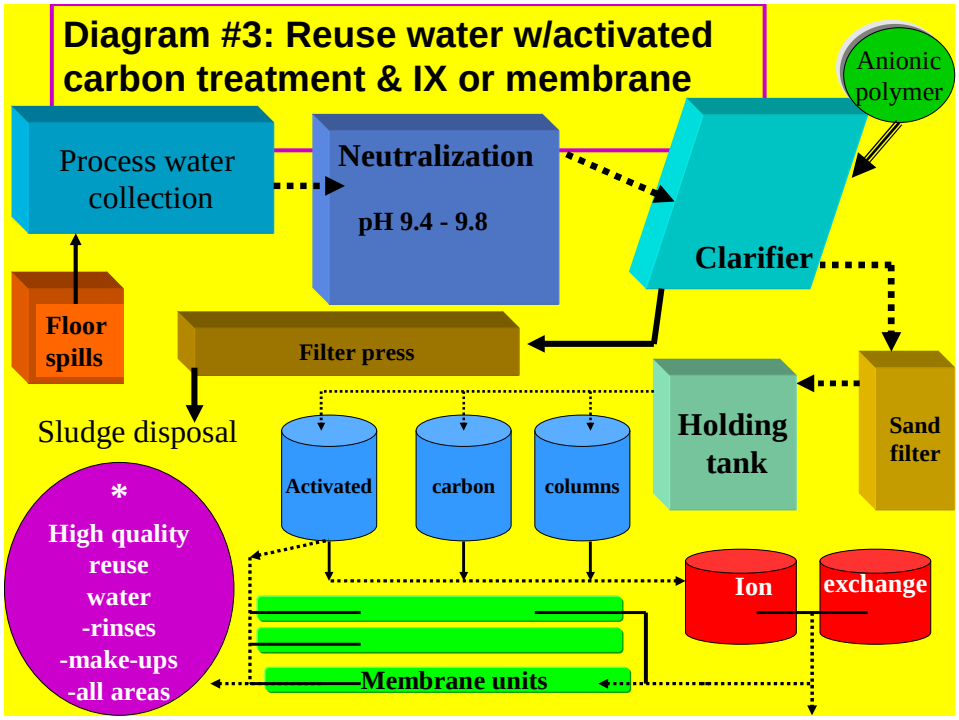
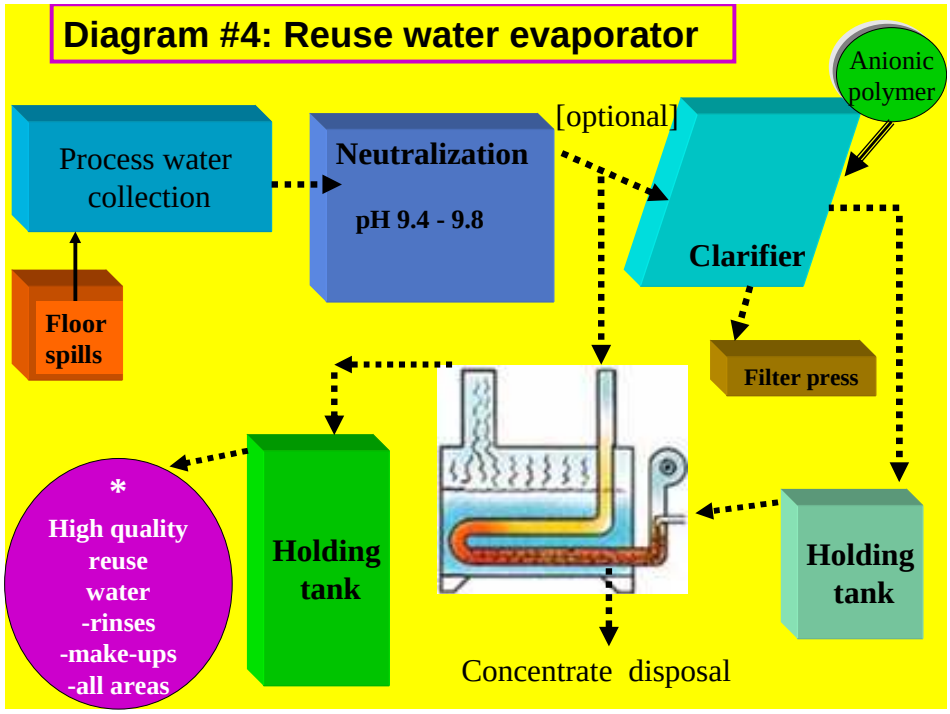


Diagram #2: Reuse water with activated carbon treatment
Anionic polymer
Process water collection
Neutralization
pH 9.4 - 9.8
Clarifier
Floor spills
Filter press
Sludge disposal
activated
carbon
columns
holding tank
Sand filter
Rinse waters process cooling cleaner make-ups





COVENTYA Inc.
WaterCare
4639 Van Epps Road
Brooklyn Heights, OH 44131
www.coventya.com
Phone: +1 216 351-1500