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Lubrication of Clarification Equipment at Wastewater Treatment Plants

Process Overview

Clarification is the process of removing turbidity, sediment and floating material from wastewater. Removal of these impurities – including solids, grease and scum – prevents them from interfering with subsequent treatment. The dissimilar nature of the suspended and floating material in wastewater is the source of much of the difficulty and expense of treatment. The solids can range in density from sand and gravel to feathers and rags. To remove all materials sufficiently, a wide range of processes are employed.

Clarification is not a single process but a combination of different processes. Large suspended solids are removed by screening or are settled down by gravity. Non-settleable material is removed through coagulation, flocculation and sedimentation. Collectively, these processes are called clarification, which can be divided into two major areas: pretreatment and primary clarification.

Pretreatment

The purpose of pretreatment is to protect the operation of the wastewater treatment plant by removing anything that can clog or damage pumps, or interfere with subsequent treatment processes. Pretreatment is designed to:

- Remove or to reduce in size the large, entrained, suspended or floating solids. These solids consist of pieces of wood, cloth, paper, plastics, garbage, etc. together with some fecal matter.
- Remove heavy inorganic solids such as sand, gravel, metal and glass. These objects are called grit.
- Remove excessive amounts of oils or greases.

Plants achieve these objectives using a variety of processes, including screening, degritting, comminuting and degreasing.

Screening

Screens are the simplest way to remove suspended matter and oversized material that might damage equipment or disrupt the treatment process.

- **Fine screens** are used effectively in industrial waste pretreatment for removal of solids not easily handled by sedimentation basins. They remove fibrous waste and other particulate matter that is separated easily from water. Fine screens are used for a wide range of industrial and commercial wastes and for domestic wastewater that has been stabilized by biological or chemical procedures.
- **Disc screens** are made of stainless or alloy wire cloth mounted on a rigid circular frame that rotates on a shaft in a channel perpendicular to the direction of the flow. The lower half is submerged so that solids impinge on the surface of the screen and are lifted in the rotation cycle above the level of flow, where they can be removed by water or effluent spray.

- **Drum screens** consist of straining fabric mounted on a cylinder that rotates in the flow channel. Water is sprayed continuously to remove collected solids and keep the fabric clean.

Degritting

Wastewater usually contains inorganic solids such as sand, cinders and gravel, collectively referred to as grit. Grit will damage pumps and cause operational difficulties in sedimentation tanks and sludge digesters if allowed to accumulate and plug outlets and pump suctions. Therefore, it is common practice to remove this material using grit chambers. **Grit chambers** are usually located ahead of pumps or comminuting devices, and if mechanically cleaned, should be preceded by coarse bar rack screens.

Generally, grit chambers are designed as long channels. In these channels the velocity is reduced sufficiently to deposit heavy inorganic solids but to retain organic material in suspension. Devices often used for this process are gravity basins and centrifugal separators. Another removal method is the aerated grit chamber, in which air is injected several feet above the floor of a tank-type unit. The rolling action of the air keeps the lighter organic matter in suspension and allows the grit relatively free from organic matter to be deposited below.

Comminuting

Comminuting devices such as **grinders, cutters and shredders** are used to cut or break up solids to a small enough size that they can be returned to the wastewater without danger of clogging pumps or piping or affecting subsequent treatment devices. They may be separate devices to grind solids removed by screens or a combination of screen and cutters installed within the wastewater flow channel. The combination devices usually consist of fixed, rotating or oscillating teeth or blades, acting together to reduce the solids to a size that will pass through screens or grids.

Degreasing

The principle of flotation may be applied if the waste being treated contains appreciable concentrations of oil, grease or fibrous materials. **Flotation** is basically sedimentation in reverse to remove floatable materials and solids. Induced gas flotation or dissolved air flotation are methods used to cause suspended matter such as grease and scum to float to the surface of the water where it can then be removed by a skimming device and swept into a trough that discharges into the digester or into a pump sump so that further handling is not necessary.

Primary Clarification

Primary clarification consists of three steps: coagulation, flocculation and sedimentation.

Coagulation

After the pre-treatment process, water enters the first of the primary treatment processes, known as coagulation. Chemicals are added to the water in a technique called rapid or flash mixing. Mixing ensures that the chemicals are evenly dispersed throughout the water. The coagulant chemicals neutralize the electrical charges of the fine particles in the water, allowing the particles to come closer together and form large clumps called micro-floc.

Flocculation

Many **clarifier** designs combine coagulation and flocculation in one tank. Flocculation involves gently mixing the wastewater for a long period of time so that clumps formed by coagulation come into contact with each other to form larger particles called floc. The flocculation basin often has a number of compartments with decreasing mixing speeds as the water advances through the basin, allowing increasingly large floc to form without being broken apart by the mixing blades. The gentle mixing is accomplished by mechanical or air flocculation. With mechanical flocculation, large submerged paddle wheels rotate on a horizontal or vertical axis. Air flocculation

systems have diffusers along one side of the basin near the bottom to produce a gentle roll-over action perpendicular to flow.

The end product of a well-regulated coagulation/ flocculation process is water in which the majority of the turbidity has been collected into floc, clumps of bacteria and particulate impurities that have come together and formed a cluster that will then settle out in the sedimentation basin.

Sedimentation
In the **sedimentation basins**, currents and eddies are minimized to allow the floc to settle by gravity. The settled floc, referred to as sludge, is removed. Only very small unsettled particles remain in the water after the sedimentation process. Sedimentation produces an effluent wastewater that can be discharged directly to a receiving watercourse or given additional treatment.

Types of Clarifiers

A variety of clarifier sizes and designs are available to drop suspended solids from the wastewater.

Circular clarifiers remove settleable solids from waste using motor-driven revolving mechanisms to collect and concentrate settled sludge. Fresh sludge leaves the tank floor through uptake pipes attached to the rake mechanism and collects in the center launder. Fine silt or other inorganic compounds drop out at the bottom sump. Clarified effluent is discharged at the overflow around the outer rim.

A combination design uses a double compartment circular tank to handle grit removal, preaeration and clarification. Incoming waste in the center column enters the top of the inner section and air comes in at the bottom through diffusers. As grit and inorganic settle, they are scraped to a grit hopper. Settled solids are raked into a sludge trough. Peripheral feed clarifiers uniformly distribute incoming waste around the outside rim-metering orifices along the bottom of the feed channel. Once in the settling zone, the solids drop out of suspension and clarified wastewater is collected at the center launder. A rotating arm removes the sludge at the bottom.

Lubricant Recommendations

Suggested lubricants for various clarifying equipment are listed below. However, we advise you to consult your *OEM Lubrication Guide* or LE's Technical Services Department for the most accurate product recommendations.

Screens & Grit Chambers

Pump & Motors

Oil Bearings
- Duolec® Vari-Purpose Gear Lubricant (1602)
- Monolec® R & O Compressor / Turbine Oil (6403-6407)
- Multilec® Industrial Oil (6803-6807)

Grease Bearings
- Monolec® Multiplex Lubricant (4622)
- Monolec® Industrial Lubricant (4701)
- Almaplex® Industrial Lubricant (1275)
- Almagard® Vari-Purpose Lubricant (3751-3752)

Gear Reducers
- Monolec® R & O Compressor / Turbine Oil (6403-6407)
- Multilec® Industrial Oil (6803-6807)
- Duolec® Vari-Purpose Gear Lubricant (1602, 1605 & 1607)

Chain Drivers & Sprockets
- Syntemp® Synthetic Lubricant (9102)
- Almasol® Dry Film Lubricant (9200)
- Almasol® Syntemp Lubricant (9901)

Conveyor Bearings
- Almagard® Vari-Purpose Lubricant (3751-3752)
- Almaplex® Industrial Lubricant (1275)

Grinders, Cutters & Shredders

Drum Motors

Oiled Bearings

- Duolec® Vari-Purpose Gear Lubricant (1602)
- Monolec® R & O Compressor / Turbine Oil (6403-6404)
- Multilec® Industrial Oil (6803-6804)

Greased Bearings

- Monolec® Multiplex Lubricant (4622)
- Monolec® Industrial Lubricant (4701)
- Almaplex® Industrial Lubricant (1275)
- Almagard® Vari-Purpose Lubricant (3751-3752)

Oil Reservoir

- Duolec® Vari-Purpose Gear Lubricant (1602)
- Monolec® R & O Compressor / Turbine Oil (6403-6404)
- Multilec® Industrial Oil (6803-6804)

Gear Reducers

- Monolec® R & O Compressor / Turbine Oil (6403-6407)
- Multilec® Industrial Oil (6803-6807)
- Duolec® Vari-Purpose Gear Lubricant (1602, 1606 & 1607)

Clarifiers

Pumps & Motors

Oiled Bearings

- Duolec® Vari-Purpose Gear Lubricant (1602)
- Monolec® R & O Compressor / Turbine Oil (6403-6404)
- Multilec® Industrial Oil (6803-6804)

Greased Bearings

- Monolec® Multiplex Lubricant (4622)
- Monolec® Industrial Lubricant (4701)
- Almaplex® Industrial Lubricant (1275)
- Almagard® Vari-Purpose Lubricant (3751-3752)

Drive Chain

- Syntemp® Synthetic Lubricant (9102)
- Almasol® Dry Film Lubricant (9200)
- Almasol® Syntemp® Lubricant (9901)

Open Gears

- Pyroshield® Syn Open Gear Grease (5182)
- Almasol® Syntemp® Lubricant (9901)

Enclosed Gears

- Monolec® R & O Compressor / Turbine Oil (6403-6407)
- Multilec® Industrial Oil (6803-6807)
- Duolec® Vari-Purpose Gear Lubricant (1602, 1605 & 1607)

Grease Fittings

- Almaplex® Industrial Lubricant (1275)
- Almagard® Vari-Purpose Lubricant (3751-3752)
- Monolec® Multiplex Lubricant (4622)

Lubricant Valves & Sluice Gates

Grease Fittings

- Almaplex® Industrial Lubricant (1275)
- Almagard® Vari-Purpose Lubricant (3751-3752)
- Monolec® Multiplex Lubricant (4622)

Lubricant Screw Threads & Nuts

- Syntemp® Synthetic Lubricant (9102)
- Almasol® Syntemp® Lubricant (9901)

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