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The Methods and Chemistry of Industrial Wastewater Treatment

Oil Recycling and Tank Truck Cleaning

Target Pollutants: Oil Emulsions and Solids

There are many ways to treat wastewater, often more than one way to treat any particular wastewater. This narrative deals with the typical process of wastewater treatment as described in the title.

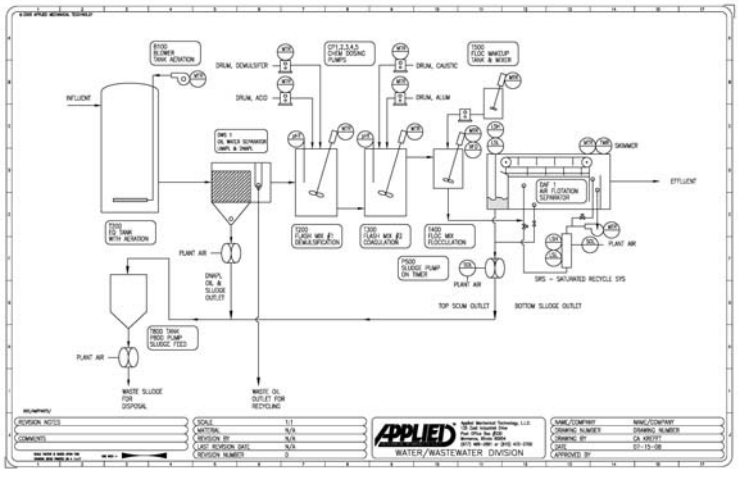
The process to treat wastewater is always based on the separation of the target pollutants from the water. First an oil water separator is used to remove gross quantity of any free oil and solids. Separation of the residual pollutants from water often requires a modification of the pollutant to an insoluble form. For example, emulsified oils and dissolved solids are not easily separated from water unless they are first precipitated and chemically de-emulsified. Pollutants are typically treated by several sequential methods. In this case stage 1 for pH adjustment to precipitate; stage 2 for coagulant to de-emulsify, and stage 3 polymer to flocculate followed by any number of ways to separate including filter, clarify or flotation. The best method of separation depends on the precipitate behavior. Chemistry and separation methods can vary significantly depending on overall wastewater chemistry the target effluent requirements.

FIRST REACTION STAGE:

The process to modify the oil from emulsified to insoluble free oil state is typically done by acid cracking. Acid cracking is done by lowering the pH to between 2.5 and 4. When the pH is lowered, the molecules of detergent and oil loose their grip on one another and the mechanical emulsion of highly mixed oils reacts by microscopically coalescing to one another forming a free oil state.

SECOND REACTION STAGE:

The process to precipitate solids is done by elevating pH using caustic to pH 8 to 9.5 while simultaneously adding a coagulant. Elevated pH causes solids to precipitate. Coagulants perform several functions. One function is to interact with the emulsified oil and detergent. The coagulant (typically alum in this case) will interfere with the oil and detergent reformation due to the higher pH. The other coagulant function is to cause the solids to form a pin floc. Pin floc occurs where the charge value (zeta P) on the surface of the molecules is reduced to near zero. This zeta P surface charge then allows the molecules to coagulate. Otherwise the molecules repel one another like magnets do. Likewise it is important to note that if the coagulant is overdosed, the zeta P surface charge then swings to the other charge value and the pin floc coagulation is gone. It is important to get the coagulant dosage correct, otherwise the process breaks down. It is also important to note that wastewater will not treat correctly UNLESS the pin floc is formed. Without pin floc NOTHING works. Get this one right!



THIRD STAGE REACTION:

Once pin floc is formed (to perfection per above), the next step is to flocculate. In this process the precipitated pin floc is mixed with a long chain polymer chemical called a flocculent. Flocculent is a long chain very complex molecule. This long chain has many "receptor" sites and is used to enmesh the pin floc particles thereby producing a "floc" particle that has sufficient structure to become enmeshed with bubbles and floated where it is then separated from the water.