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Technical Advisory #28

RECYCLING OF WASTEWATER IS PROFITABLE.

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Recently a consulting firm (NUS) conducted an annual water survey, which determined that the average price of water in the U.S.A. climbed 3.5% from July 1, 2004 to July 1, 2005. The highest price of water was found in Huntington, WV, at $5.49 per thousand gallons (Mgal). The average cost of water in the U.S was $2.34/Mgal. Including sewer costs, the national average rose to $5.78/Mgal, a 5.3% jump. That means, if a facility such as a car wash or a laundry uses 50,000 gal/month, they pay $3,500.- per year. A facility, which uses 1.2 million gallon per year, such as a steel mill, spends $7,000.- per year. In addition they have to tolerate regulators visiting their facility frequently. If such facilities where to recycle their wastewater economically, they could save money once the capitalization costs have been amortized, and they help the local community save water, which is often in short supply. This can be achieved by using a combination of an oil/water separator followed! by organically modified clay. This article attempts to describe the function and make up of an efficient oil/water separator, and the design and function of organically modified clays. Such a combination, with the possible inclusion of activated carbon, can reduce the oil content to non-detect, allowing for efficient recycling of the wastewater. The purpose of an oil/water separator is remove most of the free and non-emulsified oil and some settleble solids from the waste stream. The presence of soil particles, dirt and biological growth suspended in the waste stream allows too much oil to pass through the oil/water separator, reducing separator efficiency. Sludge created by the dirt, soil and biomass absorb oil droplets and carry them through the oil/water separator, resulting in an effluent of unacceptable quality, increased cleaning frequency and expensive change out costs. Another factor that will affect the efficiency and passing through the oil/water separator is mechanical emulsions. Mechanical emulsions of oil result due to the shearing of oil droplets to smaller sizes caused by centrifugal transfer pumps, agitation or turbulence. The most common approach to designing oil/water separator treatment systems is to configure coalescing plates that cause oil droplets to increase in size, thereby speeding the gravity separation process. The coalescing plates intercept oil droplets as the oil water mixture flows through the separator. As the radius of the oil droplets increases, droplet velocity increases per the square of the droplet radius. Larger droplets have greater buoyancy versus the smaller droplets and rise to the surface faster in accordance with Stokes Law. High surface area coalescing plates can enhance oil removal which will remove 99% oil droplets of 20 micron or greater size, maintain laminar flow by having a Reynolds number of less than 500 without the use of a high maintenance polishing media in the separator. The same design parameters used to determine oil droplets rising to the surface are a! lso used to settle out suspended particles. Efficient pretreatment equipment will reduce labor intensive cleaning and change out costs, as well as decrease the frequency of the disposal of spent media.

Organoclays are manufactured by modifying bentonite with quaternary amines, a type of surfactant that contains nitrogen ions. The nitrogen end of the quaternary amine (carboxylic head), called the hydrophilic end, is positively charged and ions are exchanged onto the clay platelet by sodium or calcium. The organoclay, which is placed into adsorption vessels, is granular and blended as a 70% anthracite/ 30% organoclay mixture. The anthracite, which has the same bulk density as organoclay, retards oil droplets from the early filling of interstitial pores due to the swelling of the organoclay. As the organoclay is introduced into water, the quaternary amine is activated and extends perpendicularly off the clay platelets into the water. A chlorine or bromine ion is loosely attached to the carbon chain of the amine. Therefore, organoclay is a nonionic surfactant with a solid base. The hydrophobic end of the amine dissolves (partitions) into the oil droplet because "like dissolves into like", thus removing that oil droplet from water. Because the partition reaction takes place "outside" of the clay particle, in contrast to adsorption of oil by activated carbon, which takes place inside its pores, the organoclay does not quickly become fouled. It can remove up to 60% of its weight in oil Since organoclay easily removes mechanically emulsified oil, and weak chemical emulsions, it acts as a polisher after the oil/water separator, removing the oil content to zero. If non-detect has to be guaranteed, a vessel filled with coal based activated carbon can be added as a final polish. Thus the oil/water separator – organically modified clay combined technologies are cost effective and an efficient method to facilitate recycling of industrial wastewater, if recycling of that wastewater is desired.

Using more organoclay and less carbon, in light of the new tariffs and thus higher prices of Chinese carbon, further results in cost savings for the end user.

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