How to Deal with Oils When Treating Contaminated Construction Dewatering Water

Sawang Notthakun, Chemical Engineer • Carbonair Environmental Systems, Brooklyn Park, MN, USA
Tel: 800-526-4999 Ext. 26 - Office • Email: snotthakun@carbonair.com • Web:www.carbonair.com

Oils are defined as organic materials that are not completely dissolved in water and present in the forms of sheens, globules, droplets. If present at a construction dewatering site, oil will most likely need to be removed from water before discharge in order to meet the discharge limits for oil & grease (O&G) and/or specific contaminants of concern (COC) that oil may carry along through treatment systems. Based on the dispersion and stability in water, oils can be classified into four different forms: 1) free oil, 2) mechanically emulsified oil, 3) chemically emulsified oil, and 4) solids-bound oil.

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Free oil is defined as oil that is larger than 20 microns in droplet size and not bound to any surface active chemicals. Free oil rises quickly to the water surface within a short period of time, and can be removed from water by buoyancy means using an oil/water separator. The droplet rising velocity is mainly dependent of droplet size and specific gravity. The larger the droplets and the smaller the specific gravity, the faster the droplets rise to the water surface. An oil/water separator can be used to remove oil droplets of larger than approximately 150 microns without the need for coalescing media. The removal of free oil droplets smaller than 150 microns requires an oil/water separator with coalescing media. Coalescing media are packing materials which are typically made of oleophilic (oil-loving) materials. In a coalescing oil/water separator, oi droplets will rise and hit the coalescing media before reaching the water surface and collide into each other to form larger droplets that rise faster to the water surface. Under the same operating condition, the size of an oil/ water separator with coalescing media will be much smaller than that without coalescing media.

Mechanically emulsified oil is defined as oil that is smaller than 20 microns in droplet size, and not bound to any surface active chemicals. Mechanically emulsified oil is typically formed by being sheared in centrifugal pumps. The oil droplets of smaller than 20 microns will rise at excessively slow velocities and cannot reach the water surface or the coalescing media in oil/water separators within a reasonable period of time. An excessively large oil/water separator, even with coalescing media, will be required to remove mechanically emulsified oil. Filtration through fabric (bag) or granular media is a more effective treatment method for the removal of mechanically emulsified oil than is the buoyancy method using an oil/water separator.

For the removal of mechanically emulsified oil, filtration with oleophilic fabric bags relies on the interception of oil droplets onto thin fabric layers (typically < 0.25 inches) whereas granular media filtration relies on the adsorption of oil droplets through deep beds of the media (typically 3-4 ft). The oleophilic bags have much smaller oil-holding capacities than do the granular media, and are recommended only where the oil concentration levels are relatively low. The granular media are typically made of either clay or zeolite, the particle surface of which are altered to be oleophilic by being impregnated and electrically charged with chemicals such as quaternary amine. These oleophilic granular media are different from granular activated carbons (GACs) which are commonly used for the removal of organic contaminants in the dissolved phase.
The surfaces of GAC particles are electrically neutral and not oleophilic. Even though the GACs are much more porous than the oleophilic clay or zeolite, most of the pores on the GACs will be too small for the oil droplets to enter. The oil-holding capacities of GACs are considerably smaller than those of the oleophilic granular media. GACs should be used for removing organic hydrocarbons only in the dissolved phase. When oil is present at a construction site and GAC is being used to remove organic hydrocarbons, it is always advisable to remove the oil prior to the GAC units so that the GAC life can be prolonged.

Chemically emulsified oil is defined as oil that is bound to surface active chemicals such as soaps, detergents, and surfactants. The molecules of these surface active chemicals consist of two distinct ends – hydrophilic (water-loving) and hydrophobic (water-hating). When surface active chemicals are added into water containing oil, their molecules will tend to surround the oil droplets by orienting the hydrophobic ends towards the oil droplets and the hydrophilic ends towards the water, forming a structure called "micelles." These micelles become repulsive to each other, and remain stable and suspended in water. The presence of chemically emulsified oil in water can be indicated by a milky or creamy appearance that does not turn clear even left undisturbed in a jar overnight. Before chemically emulsified oils can be removed from water by either buoyancy or filtration methods, the micellar structure must be broken to separate oils and surfactants from each other. Several organic and inorganic chemicals can be used as demulsifiers or emulsion breakers; however, inorganic chemicals such as aluminum and ferric chloride are commonly used. Fortunately, chemically emulsified oils are uncommonly encountered at construction dewatering sites.

Solids-bound oil is defined as oil that is attached to suspended solids. Solids-bound oil with large particle sizes can be simply removed from water by fabric bag filtration. Solids-bound oil can be troublesome when the suspended solids are very fine (so-called "colloids") and cannot be captured with the smallest micron-rated fabric bags available (approximately 1 micron). The presence of colloids in water is indicated by a cloudy or hazy appearance that does not turn clear even left undisturbed in a jar overnight. If not removed from water before discharge, the colloidal solids-bound oil may result in the exceedance of the discharge limits for oil & grease or compounds of concern such as polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs). In that case, chemical flocculation followed by sedimentation and filtration will be required to remove the colloidal solids-bound oil. There are a great number of both organic and inorganic chemical flocculants available on the market. Examples of commonly used inorganic flocculants are alum (aluminum sulfate), ferric chloride, and polyaluminum chloride (PAC). Examples of commonly used organic flocculants are polyacrylamide (PAM), diallyldimethyl ammonium chloride (DADMAC), and chitosan (made from crab and shrimp shells). The choices of the flocculants will depend upon the required dosages determined from bench-scale jar tests and upon the toxicity levels that must be approved by regulatory agencies.

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