DETERMINATION OF AN OIL EFFLUENT GUIDELINE FOR INDUSTRIAL DISCHARGES IN THE STATE OF NEW JERSEY: IS 1 PPM REALISTIC AND OBTAINABLE?

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ABSTRACT

In order to rationally control and issue permits for discharges into the state's waters, it is necessary to have a guideline or standard to compare the discharge to. This paper sets forth criteria for the establishment of a maximum limit of 1 ppm oil in a discharge. The state has the authority to control the effluent quality and is also empowered to prohibit any and all oil discharges. One ppm of oil can be measured and the technology to treat water to that limit does exist. The need for a 1-ppm limit is demonstrated by the deleterious effects that oil has on water quality, marine biota, and water usage.

INTRODUCTION

The establishment of an effluent guideline or standard for a given parameter requires that we first determine the authority to do so as based in law. The statutes of the state of New Jersey, the water quality criteria, and the Tri-State Compact for Pollution Abatement all have a direct bearing. The technical aspects must then be examined to determine three things.

1. Can we measure the parameters in the range desired?
2. What deleterious effects does the parameter cause?
3. Is there technology suitable to treat an effluent discharge to obtain the desired quality?

The above being determined, it is then necessary for government to make a policy decision on the degree of enforcement as required by law.

Statutory requirements

The water quality criteria adopted on June 30, 1971, by the New Jersey Department of Environmental Protection (NJDEP) represent water quality objectives hopefully to be met through a rigorous enforcement program [1]. For waterways which are already polluted, all waste treatment effluents and other sources of pollution must be upgraded or eliminated to permit the restoration of quality as defined by the criteria. Control over effluent quality will be imposed as a condition for obtaining state permits for waste treatment facilities. Such facilities should be designed in keeping with the current state of the art [1]. The department is charged with gathering water quality data, studies, and bioassays in order to make scientific analysis of such information to enable it to expand specific wastewater effluent quality standards [2].

The New Jersey Water Quality Criteria [3] establish eight classifications: tidal waters (TW) 1, 2, and 3; fresh waters (FW) 1, 2, and 3; and coastal waters (CW) 1 and 2. The oil and grease requirement is least stringent for TW-3 and requires none noticeable in the water or contributing to the formation of sludge deposits. The requirements for all the others also include none deposited on the shore line or aquatic substrata in quantities detrimental to the natural biota, and none which would render the waters unsuitable for their designated uses. These designated uses include the maintenance, migration, and propagation of the natural and established biota.

There are various prohibitions against water pollution in general and against oil pollution specifically in the New Jersey Statutes Annotated (NJSA) [4]. Title 58, the water and sewage statutes, contains three applicable laws. NJSA 58:12-3 provides that no person shall build a sewer or drain from which any industrial waste, municipal waste, or deleterious matter, solid or liquid, shall flow into the waters of the state without a permit (approval) by the New Jersey Department of Environmental Protection. NJSA 58:10-1 provides that no polluting matter shall be placed or discharged into any surface water above the point from which a municipality shall or may obtain water for domestic use. The New Jersey Water Quality Improvement Act of 1971, NJSA 58:10-23.1 et seq., specifically prohibits the discharge of hazardous substances, debris, and petroleum products (defined to include oil or petroleum of any kind and in any form) into or in a manner which allows flow or runoff into or upon the waters of the state and the bank or shores of said waters. This prohibition is reiterated in title 23, the fish and game laws [5] under NJSA 23:5-28. The Delaware River is specifically protected under NJSA 23:9-36, 23:9-52, and 23:9-18. The effect of all these statutes is to prohibit, by law, any and all discharges of oil.

The state of New Jersey is a signatory to the Tri-State Compact for Pollution Abatement [6]. As a signatory, it is pledged, along with New York and Connecticut, to abate and eliminate pollution; to permit the maintenance of major fish life, shellfish, and marine life in waters now available or that may, by practicable means, be made available for the development of such fish, shellfish, and marine life; to prevent oil, grease, or solids from being carried on the surface of the waters; and to prevent the formation of sludge deposits along the shores or in the waterways. The compact created the Interstate Sanitation Commission (ISC). This commission is given the authority to determine the requirements of the compact. The states agreed to prohibit pollution of the waters within the district in accordance with the compact and also to satisfy their obligations and duties under the compact. This includes enforcement of ISC regulations and requirements. The ISC established water quality regulations [7] stating that district waters will be free from floating solids, oil, and grease to the extent that none of the foregoing shall be noticeable in the waters or deposited along the shore or on aquatic substrata in quantities detrimental to the natural biota. Also, no deleterious substance shall be present in concentrations such as to be detrimental to fish or which would produce

offensive tastes or odors or be unhealthful in biota used for human consumption. The commission had adopted an effluent requirement of 1 ppm [8] for grease and oil based on the above and also on a study [9] done by Rutgers University which was commissioned by the ISC. This study determined that the harbor taste in fish was caused by oil present in quantities of 1 ppm or less in the waters in which the fish lived. New Jersey is therefore also required to enforce this requirement or a more stringent one in those district waters which lie within its jurisdiction.

Detectability and analytical methods

Many questions arise over a definition of what is oil and grease. For purposes of uniformity and practicability, oil and grease are defined as those materials which are measured by a standard test which is accepted as analyzing for oil and grease. This can either be based on a solvent-extraction-gravimetric method as in *Standard Methods* [10], on the ultraviolet analyzer [11,12] or on an infrared analyzer [13]. The extracting solvents normally used are trichloro-222 trifluoro ethane, petroleum ether, or hexane. Each extracts a slightly different fraction. The TAI Series 660 is represented as being capable of measuring as little as 0.1 ppm with a 1% sensitivity when calibrated in the 0-10 ppm range [12]. This instrument is a dual-beam UV analyzer which corrects for turbidity with a comparison beam and for free oil by using a mechanical homogenizer. The United States Environmental Protection Agency uses an infrared procedure which will quantitatively determine total hydrocarbon (oil) in water at the 10-microgram/liter level [13]. The ISC is conducting comparisons of analysis using gravimetric and infrared methods for analyzing standard samples [14]. These show very good correlation, particularly in the 0 to 100 ppm range.

Effects of oil on the environment

The primary reason for establishing water quality criteria and effluent standards is to protect the environment. The section on law disclosed that this includes oil noticeable to humans as well as the tainting effect which oil can have on fish and other marine biota. Studies [15,16] show that human beings are capable of olfactory perception of gasoline in water in concentrations of 0.2 mg/l and of fuel oil in concentrations of 0.7 mg/l. Research by the National Institute of Public Health has established the threshold for fuel oil and gasoline at 0.05 to 0.1 mg/l of water. This would show that even less than 1 ppm of oil is noticeable.

Another deleterious effect of the oil is that upon the biota of a waterway. The effects of gross oil spills are not pertinent to this paper. Rather, the cumulative effect of low concentrations is of issue. As previously mentioned, the ISC commissioned Rutgers University to study the effect of oil on fish flavor. Their study [9] showed that concentrations of 1 ppm or greater caused a harbor (oily) taste in fish. Studies [17] done in the Soviet Union on sturgeon, roe, embryos, juveniles, zander, wild carp, bream, roach, gaby, and crab showed that petroleum was toxic in doses of 0.03 to 0.05 mg/l in an aqueous solution. The federal government [18] has reported that crude oil concentrations in water as low as 0.01 ppm cause tainting in oysters. There are other studies [19] that report oil toxicity to eggs of Black Sea fishes as low as 0.001 ml/l. We see that even less than 1 ppm of oil in water will have a deleterious effect upon marine biota.

Technology and precedents

It is all very well to have an esoteric paper justifying a standard, but it is not practical unless technology is sufficiently advanced to meet it. The removal of oil from water has a long history. Before the age of pollution control, there was a need to treat process and boiler water to remove oil. Betz [20] reported the use of coated diatomite in filters used to remove oil: "Applications of this type of filter have produced a filtered condensate of practically 'zero' oil content with an influent oil content as high as 50 ppm." He also reported that chemical coagulation and filtration, or diatomite absorption and filtration, are the only certain means for the removal of emulsified oils.

Today, other methods of treatment are available [35]. These include activated carbon, reverse osmosis, ultrafiltration, chemical flocculation with dissolved air flotation, biological treatment, and chemical additions. The use of any one method or combination of methods would depend on the volume and quality of the wastewater to be treated. The above methods have been proven to the extent that user companies and vendors are able to guarantee their success. National Tank Company reported [21] that a full scale treatment plant treating water contaminated with a petroleum-based coolant stabilized with alkylaryl sulfonate emulsifiers has produced an effluent with less than 1 ppm oil content when operated with sodium aluminate/acid/polymer treatment. This plant also used flotation and filtration of floc. Fram Corporation [22] and United States Filter Corporation [23] have both represented that they can fabricate systems to remove soluble, free, and emulsified oils from water down to the 1 ppm range. More exotic methods using mutant bacteria to eat oil in water have been developed by Bower Industries, Inc., [24] and by Worne Biochemicals, Inc. [25]. Worne claims 100% degradation of oil under test conditions. Westinghouse [36] reports 99% oil removal for soluble oils using reverse osmosis: "Reducing 25 ppm of oil to 1 ppm is a reasonable and attainable objective with a Westinghouse System."

Within the state of New Jersey there are systems built, under construction, or proposed which can meet the proposed 1 ppm standard [26]. The Exxon, U.S.A., Corporation plant located in Bayonne has 2 wastewater treatment facilities. The eastside separator equipped with dissolved air flotation and chemically augmented flocculation has been sampled and found to discharge less then 1 ppm of oil. Calgon, engineers for Amerada-Hess Corporation, has presented to the NJDEP plans and specifications for a proposed wastewater treatment facility to be located in Woodbridge Township, New Jersey. The pilot work done by Calgon shows that it will be successful, and Amerada-Hess has guaranteed it. New Jersey has also received commitments from Chevron [16], Cosmopolitan Terminals [27], and Shell Oil [28] that these companies can and will meet the 1 ppm oil limit in the discharge from their new facilities. Across the river in Pennsylvania, the BP Oil Company has built a new treatment facility for its Marcus Hook refinery. The pilot work done for this plant showed that activated carbon columns are capable of producing an effluent of 1.8 ppm oil average with a range of 0.8 to 2.5 ppm [29]. This was run with an average influent of 12.3 ppm from a sand filter. These columns were run to exhaustion. It is reasonable to expect that prior to exhaustion the effluent contained less then 1 ppm oil.

Application of the 1 mg/l oil and grease standard for water discharges

The origin of waters within a particular industrial facility can generally be classified into four groups: surface waters, ground waters produced within confines of the facility, storm waters, and municipal water supplies. The question has arisen as to whether or not the effluent requirement of 1 mg/l oil and grease should be applied to discharges where the raw water or intake water contains an oil and grease content greater than 1 mg/l. When looking at the possible sources of water, one can conclude that the municipal supplies and the storm water from heaven do not contain any quantity of oil and grease. Therefore, any introduction of oil into those waters in excess of 1 mg/l would be in violation of the requirement.

We next look at the surface water quality and ground water quality underneath and contiguous to the industrial facility. The state of New Jersey does not have any known natural sources of petroleum seeps to our knowledge. The existence of petroleum measured as oil and grease within both surface waters and ground waters is the result of mankind's industrial development and the effluents created thereby. While some may argue that it is unfair to require a facility to clean up water to a level greater than that which it receives, we must find that all of man's actions are responsible for the original contaminated conditions and therefore only through man's action can these conditions be alleviated. This means that there is no defense for failure to produce an effluent which will not have deleterious effects upon the natural biota which would exist if a receiving stream were to meet its required surface water quality.

Since the effluent requirement would be equally applied to all, all industry would have to incur the same costs and therefore still be competitive with one another. Some may argue that the sins of the preceding generations should not be visited upon today's industry. We do not agree with that, since the only way to improve water quality to required levels would be, in some cases, to require that the users of our waters clean them up to a condition greater than that in which they found them. After all, these waters are in their present contaminated conditions because of previous operations by these same industrial sources.

Policy and enforcement

New Jersey first used 1 ppm oil as an effluent requirement in an administrative order [30] issued to the Central Railroad of New Jersey on November 19, 1971. A judicial precedent was set in a court consent order [31] between the NJDEP and Standard Tank Cleaning Corporation.

The preceding sections of this report show that 1 ppm of oil can be measured, does present a detriment to the environment, and can be treated. There is also statutory justification for regulating oily discharges. The state cannot effectively mitigate the environmental degradation caused by oil unless it has the tools to actively enforce against oil dischargers. This should be done through regulations and encouraged enforcement. Also, industry can better plan and allocate money for pollution abatement if they have a required target.

Other government agencies are also moving in the direction of strict enforcement. The ISC [8] already is enforcing 1 ppm. The federal government is also moving in this direction. They have given Amerada Hess [32] an effluent limit of 2 ppm of oil for their new waste treatment system. They have also given 1 ppm to Allied Chemicals [33] for their proposed Morristown treatment facility. The Delaware River Basin Commission has recognized this trend and formed an oil subcomittee [34] to report on the state of oil discharge requirements in its region.

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