TREATMENT OF SEWAGE CONTAINING OIL AND SLUDGE IN TRANSPORT INDUSTRY

Lajos SZÉPKUTI, Zoltán PÓTH and Imre V. NAGY

Department of Water Management
Technical University of Budapest
H–1521 Budapest, Hungary

Received: March 31, 1994

Abstract

This paper provides a brief review of main characteristics of sludges of the transport industry containing oil suspensions of inorganic, metallic and non-metallic origin and surface-active detergents. As a result of in-situ and laboratory investigations, a general treatment system and two new sets of equipment, a tangential settler and a special filter block are proposed for the treatment of that type of waste waters.

Keywords: industrial sewage treatment, transport industry.

1. Introduction

It is known that in the transport industry the following types of the sewages can be mainly found:

- cooling water of compressors and pumps containing oil,
- waste waters of vehicle washing (without using detergents) contains oil and suspension with non-metallic character,
- oil-contaminated waste waters from vehicle washing different types of surface-active detergents,
- sewages containing metallic and non-metallic suspensions and different types of surface-active detergents.

In this paper, the treatment methods of the first, second and, partly, the third types of sewages are introduced, but the conclusions can be applied to the fourth type of sewages, too.

2. Main Characteristics of the Investigated Emulsions

The Department of Water Management of the Technical University of Budapest cooperating with different Departments of Chemical Faculty has performed series of investigations in the last 20 years for the elaboration of treatment methods of waste waters of the transport industry. Different types of oil-emulsion have been analysed.

Sewages containing oil-emulsions can be treated as heterogeneous, unstable systems in which another liquid (oil) is dispergating in form of particles having diameters in average more than 0.1 μ. The instability can be increased by the suspended particles and surface-active detergents, consequently, the character and treatment possibilities are determined by the physical-chemical composition of the sewage.

From the point of view of primary cleaning, floatation and rejuvenation, the emulsions of waste waters of the transport industry can be classified as ones having small, average and high time-constants.

- When washing engines by pressurized hot water alone, sewage contains emulsions with small time-constant, consequently, the floatation of the oil can be performed by using a traditional settler.
- In vehicle washing stations — cleaning carriages and underframes — the solid suspended particles (clay, metal, soot) will occur in the sewage and, as a result of the adsorptive capacity of oil, and the separation of pollutants is delayed.
- When using detergents having different characteristics, the time-constant of emulsions will increase, there is a decrease of average diameters of oil particles, and the upward velocity of oil drops (in the diameter range of 0.1–1 μ) will approach zero, consequently the value of time-constant is very high.

As a result of our investigations, the fact has been stated that by using tensides or other surface-active detergents producing stabilizing effect, the dispersion of the oil can occur (originating emulsions, with high time-constant), and an for increased quasi-solubility of emulsions is possible.

If the applied detergent has alkaline reaction and, as consequence of NaOH content, the saponification may occur then the treatment capacity of the oil interceptor will decrease. In that case, there is a need for the neutralization of the alkaline effect, too.

Taking the above mentioned problems into account, the appropriate method of treatment depends on the:

- physical-chemical composition (oil, sludge, pH value, type of detergents) of the sewage,
- discharge-time characteristics of the waste water,
- prescribed level of treatment in the case of recirculation, and inflow into the sewerage system or water course.

In the next part of our paper we will to introduce a treatment system successfully applied for purification of oil-contaminated waste waters.

3. General Characteristics of the Treatment System

The schematic representation of the treatment system is presented in *Fig. 1.* The equalization, mechanical and chemical treatment of the raw sewage is performed by an equipment (tangential settler and oil interceptor) fitted with a tangential water inlet (having a specially shaped inside part) which contains a central storage space for collecting oil and sludge (*Fig. 2*).

The discharge of the raw water and the mean circulation (spiral) velocity depend on the settling rate (hydraulic screen size) of the suspended matter and on the average ascendant velocity of the oil particles. In the case of appropriate velocity conditions, a part of the suspended particles will settle down in the lower part of the device and can be elevated to the sludge thickener by a simple mechanical equipment. There is a possibility for increasing the treatment efficiency by introducing a cleaning clarifier into the central part of the settling pool.

The suspended, floating oil particles can be collected at the upper external part of the equipment. The oil content of the treated sewage is 30–50 g/m^3. For a further treatment a special filter block is applied.

4. Special Filter System

In order to increase the specific capacity of the treatment system, a new type of filter was introduced as a result of hydraulic investigations. The basic idea is the recognition of the fact that the suspended particles of natural and artificial origin remaining in the balancing tank (2) and pumped to the filter (3) will agglutinate on the filter surface (*Fig. 2, Fig. 3*) and can be removed from that by using a tangential inflow of the raw water polluted by oil and suspended sediment.

The main average circulation velocity should be determined as a function of terminal settling velocities of solid particles in a fluid of known properties. As a result, a determined amount of suspended sediment will settle in the lower part of the cylindric annular filter (3) and can be removed by periodic opening of the gate valve (4).

At the moment of the opening of the valve, due to underpressure in the filter, a blackflow of the already filtered water will partly backwash the material of the filter. The filtered waste water is collected by a funnel (5) and discharged into basin (6) of the treated water or to the next filter.

Concentration of the oil and suspended matter both in the inflow and effluent is continuously measured and, in the case of determined hydraulic resistance, the backwash process starts.

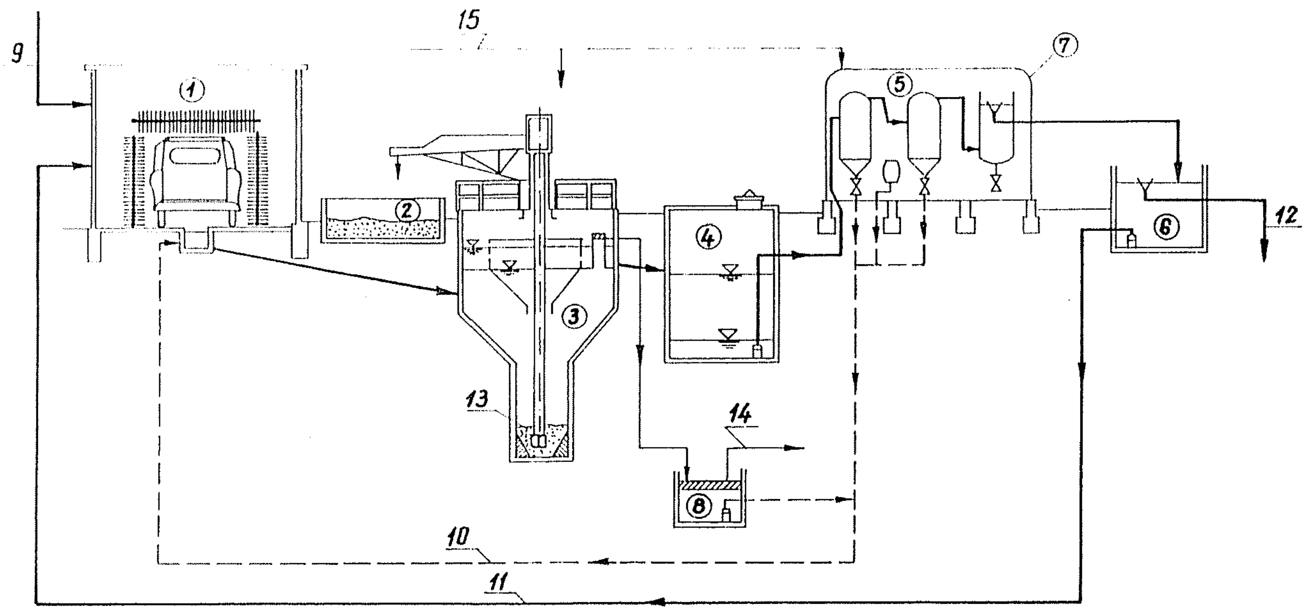

Fig. 1. Schematic representation of the treatment system
1. Vehicle washing; 2. Sludge concentrator; 3. Tangential interceptor; 4. Balancing tank, pump; 5. Oily sewage filter unit; 6. Service water reservoir; 7. Container; 8. Oil collector; 9. Clean water; 10. Chemically combined return flow; 11. Toward water recipient; 12. Water for reuse; 13. Sludge; 14. Oil; 15. Compressed air

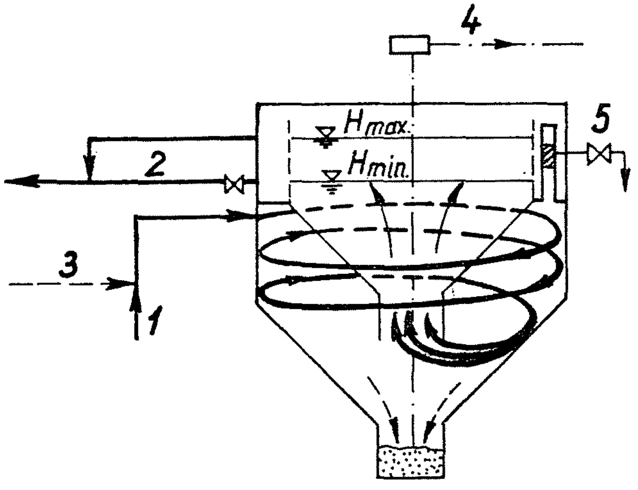

Fig. 2. Tangential settler and oil interceptor
1. Raw sewage; 2. Treated water; 3. Clarifier dosing; 4. Sludge; 5. Oil removal

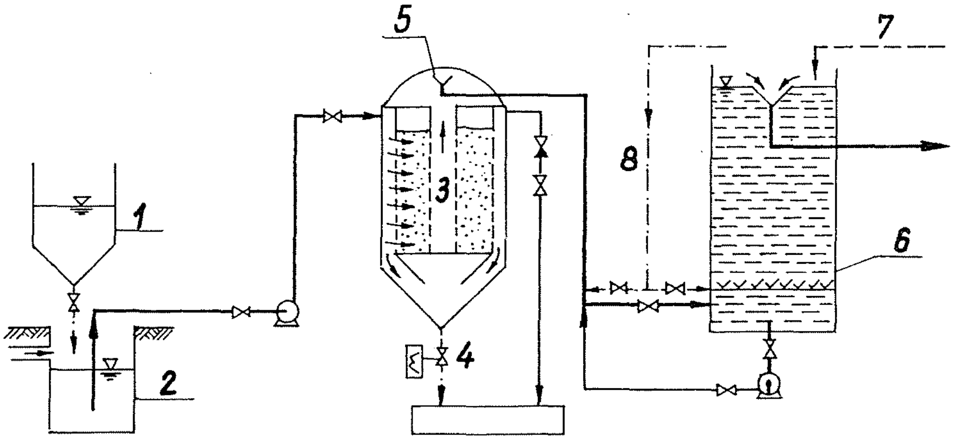

Fig. 3. New filter system

The backwashing of the filter (3) is performed with the pumped hot water (7) by adding high compressed air (8) with a pulsator into the water conduit.

Favourable characteristics of the proposed filter system (filled with quartz or/and active carbon) are the higher specific filtering surface and the possibility of simple automatic (self-acting) regeneration of the filter.

A built-in equipment (1) for dosing chemicals serves the sewage purification, as well as disinfection of the filtered and aerated waste water. Usually the purified waste water has an oil content of 2–5 g/m^3, thus, it is suitable for recirculation and reuse.

The proposed filter system applied successfully in practice (situated in the container, and fit also for winter service) has a treatment capacity of 100–300 m^3 a day and is widely used in vehicle service stations.

5. Conclusion

Units of the treatment system (equipment set) introduced here, modified and widely applied in Hungary can be used both together and separately, and may be combined with other treatment processes. Considerable investment costs can be saved by the proposed system combining various sewage treatment functions, namely the oil and sludge removal. Usually the purified waste water has an oil content of 2–5 g/m^3, thus, it is also suitable for recirculation and reuse. The filtering equipment may be also used for pretreatment of raw river-waters serving drinking water supply.

References

1. BECHER, P.: Emulsions. Theory and Practice. American Chemical Society, 1965. New York.
2. BUZÁGH, A.: Colloid Chemistry. Akadémiai Kiadó, 1952. Budapest (in Hungarian).
3. FARKAS, M. – NAGY, I. V.: Modelling of the Depth Filtration. Acad. of Sciences 628.31, 1987. Novi Sad.
4. ÖLLŐS, G.: Sewage Treatment I–II. AQUA, 1991. Budapest (in Hungarian).
5. PERRY, J. H.: Handbook for Chemical Engineering. Műszaki Könyvkiadó, 1968. Budapest (in Hungarian).
6. WOLFRAM, E.: Colloid Chemistry. Tankönyvkiadó, 1970. Budapest (in Hungarian).
7. Chemical Treatment of the Waste Water from Spare Parts and Primary Sets Cleaning. Final Report of Research Department for Watermanagement and Department of Physical Chemistry, Technical University, 1990. Budapest (in Hungarian).