

# PURIFICATION OF WATER CONTAMINATED WITH OIL BY THE PROCESS OF HYDRODYNAMIC CAVITATION

Dorđe Ogrizović

Supervisor: Borivoj Adnađević, PhD, Faculty of Physical Chemistry, University of Belgrade

Regional Center for Talented Youth Belgrade II, Belgrade, Serbia, djordje.o@sbb.rs

## 1. Introduction

The lack of pure drinking water represents an increasing global issue. Oil is one of the most common and the most dangerous organic pollutants of the industrial wastewater and environment. Crude oil is a mixture of alkanes, cycloalkanes, aromatic hydrocarbons and other organic compounds which reaches the water through industrial and municipal waste, with inadequate monitoring, as well as leaking from oil wells or tankers in which the oil is transported [1]. In order to remove oil from water, numerous methods are used, which have a number of deficiencies such as high price, poor efficiency or indiscriminate purification [1]. In this research the method of hydrodynamic cavitation has been applied as a potential new way of solving this global problem. The aim of this study is to examine the possibility of removing oil from water by using hydrodynamic cavitation methods depending on the different time intervals.

## 2. Experimental Setup

Concentration of oil in the aqueous solution is determined by a standard method [2]. UV spectra are recorded on a spectrophotometer of type UV mini in 1240 (Shimadzu, Japan). A standard calibration curve is made afterwards. For research purposes a hydrodynamical cavitator of Venturi type has been constructed and built. The dependence of the discharge pressure has been examined to determine the cavitation number which equals 0.1. The water with oil has been oozed through the cavitator at time intervals of 5, 10, 15 and 20 minutes and the initial concentration of oil in the aqueous solution equals 1.45 g/l. The influence of the concentration of hydrogen peroxide ( $H_2O_2$ ) was examined. The amount of oil removed from the water ( $\alpha$ ) has been calculated by the formula:

$$\alpha = \frac{C_0 - C_1}{C_0} \cdot 100\% \quad (1)$$

where  $C_0$  is the initial concentration, and  $C_1$  is the concentration of oil (after the cavitation process) in aqueous solution.

## 3. Results

Figure 1 shows the effect of time on the percentage reduction in the concentration of oil in water.

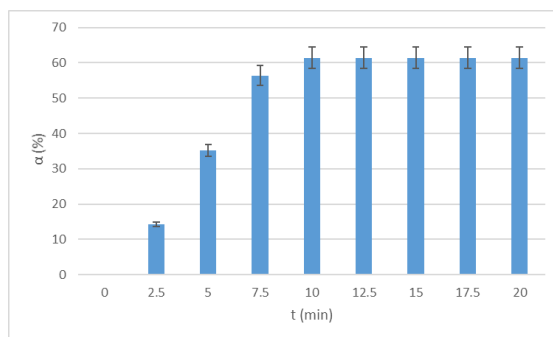


Figure 1 – The dependence of the percentage reduction of the concentration of oil in water by the time

From the table it can clearly be seen that the concentration of oil in water in the first 5 minutes drops by 35.17% and in the range of 10 minutes it drops by 61.38%. Unexpectedly, after ten minutes the concentration does not change. That can be explained by the possible lack of hydrogen peroxide. The influence of hydrogen peroxide is presented in table 1 and was examined at the same concentration of oil, at time period after 10 minutes. With the increase of hydrogen peroxide in water, the degree reduction of oil content is higher.

Table 1 – The influence of  $H_2O_2$  concentration on the degree of reduction of the oil content

Concentration of hydrogen peroxide (mg/l)	300	400	500
Degree reduction (%)	60.1	71.3	80.4

## 4. Conclusion

Hydrodynamic cavitation was proved to be an effective method for removing oil out of water. After the first 10 minutes the quantity of oil in the water decreased by 61.38%, as compared to other methods [1], under the same conditions, is much more efficient. This process depends on concentration of hydrogen peroxide. When the concentration of hydrogen peroxide is 500 mg/L the degree reduction is more than 80%. In further research it is necessary to examine the effects of the influence of pH value and temperature.

## 5. References

- [1] Yu, Li, Mei Han, and Fang He. "A review of treating oily wastewater." *Arabian Journal of Chemistry* (2013).
- [2] Z. Huiying. "Determination of oil content in wastewater by ultraviolet spectrophotometry." *CJI*, vol. 11 (9), pp 41, (2009).