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FLOATING AGGREGATES WITH IMMOBILIZED BACTERIA VS FLOATING OILS: SEARCH FOR APPROPRIATE CERAMICS

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The natural granular aggregates are used for removing floating crude oil from water surfaces via its transformation into immobile phase. About 50% of the floating oil can be removed by limestone and quartz sand aggregates, when granular material to floating oil ratio is about 1 g/g [Boglaenko and Tansel, 2015]. Once the oil-particle phase separated, additional measures should be taken for remove of the remaining hydrocarbon contamination on the water surface. For that purpose, microorganisms with hydrocarbon-degrading activity could be attached on the carrier, which is appropriate for biofilm formation and has floating properties. Various organic and inorganic materials are used for immobilization of microorganisms. For wastewater treatment the carrier must be mechanically and chemically stable, non biodegradable etc.

The aim of this study was to produce the ceramic beads with bulk density below 1 g/cm³ with further their testing for floating ability in the presence of synthetic wastewaters, silicone oil and hydrocarbon-degrading bacteria consortium under laboratory conditions. The pellets of Quaternary clay with additive of 45% of milled SiO₂ and 3% sawdust were investigated. The part of the pellets before sintering are coated with the same SiO₂ powder to decrease the agglutination of pellets in fabricating process. Dry pellets are put into kiln, heated up to 1200 °C and expose during 10 min at this temperature. Bulk density of these pellets is 0.95–1.00 g/cm³. X-Ray analysis of pellets show presence of high amount of glassy phase. Crystalline phases are represented with quartz and hematite in the sintered pellets.

Composition of the synthetic wastewaters was as follows, g L⁻¹: CO(NH₂)₂ – 0.06; (NH₄)₂SO₄ – 0.132; Na₂HPO₄ × 12H₂O – 0.716; MgSO₄ × 7H₂O – 0.123; CH₃COONa – 0.1; NaCl – 0.05; trace element solution – 10 mL (with the following composition, g L⁻¹: CoCl₂ · 6H₂O – 0.1; ZnSO₄ – 0.1; CuCl₂ · 2H₂O – 0.01;

H₃BO₃ – 0.01; Na₂MoO₄ – 0.01; NiCl₂ · 6H₂O – 0.02). 500 mL synthetic wastewaters were amended by 1 mL silicone oil (Aldrich, CAS: 63148-62-9) and 5 mL inoculum of bacterial consortium (1.0 × 10⁹ CFU/mL).

During the 70 days experiment the floatage of the SiO₂-treated beads gradually decreased up to 15%, irrespectively of the presence of oil and bacteria. In turn, sedimentation of non-treated beads was retained in the presence of oil. Thus, after 70 days, the percentage of floating beads in the sets with synthetic wastewaters, synthetic wastewaters + silicone oil, synthetic wastewaters + silicone oil + bacterial consortium was found to be 20.5 ± 9.7 %; 47.6 ± 7.1 %; 36.2 ± 9.2 %, respectively.

REFERENCES

- Boglaenko, D., Tansel, B. (2015). Instantaneous stabilization of floating oils by surface application of natural granular materials (beach sand and limestone). *Marine Pollution Bulletin*, 91, 107–112.