Interaction of polyacrylamide floculants and acrylamide with clays, soil and sediments

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Polyacrylamide flocculants are used in numerous fields, particularly for water treatment and offshore oil production. These polyacrylamide polymers, with an ultra-high molecular weight, are produced from acrylamide monomer, which is known to be an animal and a suspected human carcinogen. The fate and transport of acrylamide and polyacrylamide flocculants in the environment in the above contexts have never been studied yet. In this study, we were interested in acrylamide and 2 anionic polyacrylamides of different molecular weight: the first one is used as flocculent in an aggregates quarry, and the second one is used in offshore oil extraction. For both acrylamide and polyacrylamides, batch experiments (sorption isotherms) according to the protocol developed by the Environmental Protection Agency (EPA) [1] were conducted on mineral soil phases, soil materials and sediments to determine the partition coefficient between the solid and the liquid phase (Kd), and to provide a better understanding of these molecules fate when they are in contact with natural solid phases. For acrylamide and the polyacrylamide used in the aggregates quarry, the tests were performed in freshwater with clays and sludge from one quarry site. For polyacrylamide used in petrochemical, experiments were carried out in sea water with clays and marine sediments.

Adsorption isotherms obtained for acrylamide indicate a weak affinity of acrylamide to clays (kaolinite and illite) and to soil samples (Kd < 0.9 ml/g). These results are consistent with those of Arrowood (2007) [2] who found low adsorption percentages (0-2.4%) of acrylamide on three soil types. This low affinity can be explained by the high solubility and hydrophilicity of acrylamide, its small size and the negative charges of both acrylamide and the surfaces of solids tested, as shown by zeta potential analyzes. Acrylamide is mobile in the soil since it cannot be trapped by mineral particles. Unlike the acrylamide, the two polyacrylamides tested showed a strong affinity to clays, sludge and sediments.

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