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T_2 And Proton Density Mapping Of Pollutant Oils In Estuarine Sediments

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In order to facilitate decontamination of polluted beach material a method of quickly determining the rate of movement of crude oils in marine sediments has been developed using MRI. This work is extended to include the calculation of the degree of binding between the contaminant and the substrate.

Magnetic resonance imaging (MRI) is now widely used in various aspects of the oil industry to give a measure of the relative speed of diffusion of oil within sediment and also of the binding between the oil and the sediment plus how both change with time.

MRI makes use of the interactions between atomic nuclei and an external, strong, magnetic field to map the distribution of these nuclei through a substance. In this case, the proton, the nucleus of the hydrogen atom is used to show the presence of oil in the substrate. Maps of relative oil density, and hence concentration, and of the magnetic resonance relaxation rate, T_2, are produced. T_2, which is greatly influenced by molecular motion, can be equated to binding between the oil and the sediment, thus these maps provide an almost real-time 'description' of all aspects of the oil/sediment interaction.

In this paper the results of measurements, by MRI, of interactions between three sediments from the Tay Estuary (East coast of Scotland) and three crude oils (Fulmar, Forties and Venezuelan) will be discussed. The ability of MRI to distinguish between the rates of flow of the oils into the sediment and the strengths interaction between the various sediments and oils is demonstrated.