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Mutagenic Activity of Surface Waters Adjacent to a Nuclear Fuel Processing Facility

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Abstract. Surface waters adjacent to a nuclear fuel processing facility were extracted, using XAD-resin adsorption followed by solvent elution, and the extracts were assayed for mutagenic potential by the Ames *Salmonella*-mammalian microsome test. Dose-related mutagenic responses with TA102 (+S9) were produced with the extracts of water samples obtained from a creek receiving wastewater from the processing facility (specific mutagenic activities of 7,250 to 8,250 net revertants per L equivalent of water). The creek water extracts were not mutagenic with TA102 in the absence of S9, or with any other tester strain (i.e., TA97, TA98, TA100, and TA1535) in the presence or absence of S9. Surface water samples downstream and upstream of this creek were not mutagenic; apparently indicating the lack of persistence of the observed mutagenicity. The major constituent in the mutagenic creek water extracts was identified as tributylphosphate (TBP) by gas chromatography-mass spectrometry. However, TBP was not mutagenic with TA102 (+S9) at doses ranging from 196 μg/plate to 9.8 ng/plate. Because tester strain TA102 detects oxidative mutagenesis due to x-rays and ultraviolet radiation, it is possible that the observed mutagenicity of creek water extracts was due to radionuclides complexed to TBP.

Significant mutagenic activity has been detected in a variety of industrial wastewater effluents and sludges. Among mutagenic industrial discharges are petroleum refinery effluents (Metcalfe *et al.* 1985), petroleum refinery sludges (Donnelly *et al.* 1985), coke-oven effluents (Van Hoof and Verheyden 1981; Van Hoof and Manteleers 1983), chlorinated pulp mill effluents (Rannug 1980), textile manufacturing effluents (Möller *et al.* 1984), foundry effluents (Somani *et al.* 1980), and wastewaters from the production of nitrobenzoic acids (Sundvall *et al.* 1984), nitrotoluenes (Spanggord *et al.* 1982; Sundvall *et al.* 1984), acetonitrile (Brown and Donnelly 1984) and vinyl chloride (Rannug and Ramel 1977). Mutagenic industrial wastewaters discharged to municipal sewer systems are major contributors to the observed mutagenicity of municipal wastewaters (Ellis *et al.* 1982; Meier and Bishop 1985; Rappaport *et al.* 1979; Reinhard *et al.* 1982). Moreover, the release of mutagenic industrial and/or municipal wastewater effluents into surface waters has produced measurable mutagenic activity in these systems (Maruoka and Yamanaka 1982, 1983; Moore *et al.* 1980; Van Hoof and Verheyden 1981).

There is an urgent need to characterize the mutagenic potential of many, yet untested, industrial wastewater effluents, and of surface waters into which they are discharged. The present study focuses on the mutagenic activity, as determined by the Ames *Salmonella*-mammalian microsome test, of surface waters (*i.e.*, Nolichucky River Basin, upper-east Tennessee) receiving wastewater from a nuclear fuel processing facility (*i.e.*, Nuclear Fuel Services, Inc, Erwin, Tennessee—NFS). At this plant, highly enriched uranium-235 hexafluoride gas is used to manufacture the fuel employed in the reactors of U.S. Navy nuclear submarines. An extensive literature search failed to provide any other

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