1. Title: Adsorption and Desorption of Atrazine on Selected Lake Sediments in Texas.

2. Focus Categories (to be completed by institution personnel):

3. Keywords: atrazine, adsorption, desorption, sediment.

4. Duration: One year

5. Federal Funds Requested: $5,000

6. Non-Federal (matching) Funds Pledged: $10,000

7. Principal Investigation (graduate student): Judy A. Vader
   Co-Principal Investigator: Scott A. Senseman
   Co-Principal Investigator: Monty C. Dozier

8. Congressional District: 8th district

9. Statement of Critical Regional Water Problems: The herbicide atrazine has been used extensively throughout the U.S. for weed control in corn and sorghum. Atrazine has been one of the most detected herbicides in U.S. surface water (Ma et al. 1997; Seybold et al. 1999). Due to its presence in surface water, atrazine has become a growing concern regarding human and wildlife health. I has been reported that about 1% of the atrazine applied in agricultural systems is removed by surface runoff, which leads to the main source of pesticide contamination in lakes (Wauchope 1978; Spalding 1994).

   Atrazine has several fates in lake water including hydrolysis, photolysis, and adsorption to sediment. Atrazine has a low water solubility of 33 ug/ml and is moderately adsorbed to soil (K_{oc} = 100 mL/g) (Ahrens 1994). Clay content and organic matter primarily controls adsorption of this compound. There may be differences between soil and sediment that influence atrazine adsorption. Sediment is found in an anaerobic environment and usually contains a greater amount of organic matter (Seybold et al. 1999). Although there has been extensive research done related to atrazine interactions with water and soil, little has been done with atrazine interactions with sediment.

10. Nature, Scope, and Objectives of the Research:
    Results from this research will provide answers to questions regarding the potential for lake sediment to harbor atrazine over time that would allow for desorption of the compound thereby causing chronic, low-level detections of this material in lake water. Questions have been asked regarding the concentrations of atrazine in the sediment of some of these contaminated sites yet further studies of not been done to address adsorption/desorption from this type of matrix.

Sediment samples will be collected from eight central Texas lakes using an Eckman dredge. Once collected, samples will be dried in a greenhouse. Once dried the sediment samples will be ground with a mortar and pestle and then passed through a 2-mm sieve. Subsamples will be characterized to determine pH, texture analysis, and organic carbon.

Four 2-g samples will be weight for each sediment sample and placed into separate 35-ml centrifuge tubes. Initial standard solutions will be made using a radiolabeled atrazine standard combined with analytical grade atrazine in methanol. One hundred uL of the initial standard solution will be placed in a centrifuge tube fore each sample along with 5 mL of 0.01 M $CaCl_2$ solution. The atrazine concentrations in the sediment will be 0, 1, 5, 10, and 20 ug/g. Radiolabeled atrazine will be added to each sample such that each treatment will contain 2000 disintegrations per minute (dpms).

The samples will be placed on a table shaker and shaken for 24 hr. Tubes will then be removed and centrifuged. A 2-mL aliquot will then be removed from the supernatant of each sample and placed in a glass scintillation vial along with 10 mL of scintillation fluid. The samples will then be placed on a Beckman LS 6500 Multipurpose scintillation counter. Each sample will be counted for radioactivity for 20 min. The treatments will be replicated 4 times and the entire experiment will be repeated

To study desorption, the residual supernatant will be removed from each tube and new 0.01 M $CaCl_2$ will be added. The samples will be placed on a table shaker and shaken for 24 hr. Tubes will then be removed from the shaker and centrifuged. A 2-mL aliquot will then be removed from the supernatant of each sample and placed in a glass scintillation vial along with 10 mL of scintillation fluid. The samples will be counted as previously mentioned. Desorption will be repeated three times followed by a final combustion of a subsample of the remaining sediment. A mass balance calculation will be used to account for all of the atrazine in the adsorption/desorption process.

Adsorption and desorption isotherms will be constructed and affinity calculations (K_d) will be determined using the Freundlich equation:

$$X/M = KC^{1/n}$$

$$\text{Log } X/M = \text{Log } K + 1/n \text{ Log } C$$

Where X/M = the amount of atrazine adsorbed per mass of adsorbent; C = solution concentration at equilibrium; K and n are constants. K represents the affinity of the compound to the sediment.

11. Results Expected from this Project:
We expect differences in the sediment characteristics that will ultimately show differences in adsorption and desorption values between sites where sediment was collected. We also expect there to be differences in hysteresis between sediments.

References

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Ma, L. and R.F. Spalding. 1997. Herbicide persistence and mobility in recharge lake watershed in York, Nebraska. J. Environ. Qual. 26:115-125.

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Spalding, R.F., D.D. Snow, D.A. Cassada, and M.E. Burbach. 1994. Study of pesticide occurrence in two closely spaced lakes in northeastern Nebraska. J. Environ. Qual. 23:571-578.

Wauchope, R.D. 1978. The pesticide content of surface water draining form agricultrual fields – a review. J. Environ. Qual. 9:459-465.