POTENTIAL FOR NATURAL BRINE FOR ANTI-ICING & DEICING

Prior to the Civil War, the City of Syracuse, NY (known as the “Salt City”) produced much of the higher quality salt consumed by the United States of America and its growing territories from natural brine springs near Onondaga Lake. However, the salt industry in Central New York only lasted into the early part of the twentieth century. Naturally occurring brine still exists in the aquifer below Syracuse, and has the potential to be utilized in the 21st Century to provide both state and local transportation agencies with a comparatively local, inexpensive and “green” resource for snow and ice control. The naturally occurring brine, with some enhancement, may reduce degradation to the environment and roadway infrastructure through a more efficient means of applying brine for de-icing/anti-icing in the greater Syracuse area.

The present test well is located in the vicinity of the one of the many “Salt Works” that were located around Onondaga Lake. As part of this multi-agency research project, we will determine the environmental and economical benefits of applying brine. Region 3 NYSDOT has recently acquired an Oshkosh 53 foot-long former military fuel transport tanker that has been outfitted with two, 2000 gallon High Density Poly Ethylene (HDPE), pump and spray-bar units to apply the brine on selected locations in the Syracuse metropolitan area. The United States Geological Survey, the Onondaga County Department of Transportation and the Village of Fayetteville’s Department of Public Works, are a few of the select agencies involved in the project and the sharing of resources.
Natural Brine for Anti-Icing, (Continued from Page 1.)

Salt brine is to be pumped from the 6-inch diameter 170 foot deep well via a Grundfos submersible pump to the brine truck at the former Salt Barn on Van Rensselaer Street in Syracuse where it will be hauled to the Village of Fayetteville’s brine maker for processing. The existing brine concentration in the Onondaga Aquifer is approximately 15% by weight. The “raw” brine will be then be processed and boosted to the 23% by weight concentration necessary for anti-icing, therefore, saving the amount of salt that is needed when brine is produced by conventional means. The finished product will then be shared by the various agencies involved with the project.

A Request for Proposal (RFP) will be sent out to monitor the operations and help determine where and how the process could be improved. This project has proven to be quite an interesting opportunity for a number of NYSDOT employees involved in the project, as well as sharing ideas and innovations with other agencies. Not only are we rediscovering the “past”, but we are putting it all to a use that will benefit NYSDOT and other agencies in the future. USGS reports that there are several other locations in the state that could be used as brine sources in the future.

If you have any questions on this project please contact Christopher Anderson: canderson@dot.state.ny.us

UPSTATE NEW YORK SIGNAL ANALYSIS STUDY:
TRANSPORTATION R&D AT NYSERDA

In an effort to improve highway traffic operations for the benefit of the traveling public and communities statewide, the New York State Energy Research and Development Agency (NYSERDA) in collaboration with the New York State Department of Transportation (NYSDOT) and Federal Highway Administration (FHWA) funded this effort through a competitive solicitation. Awarded to Bergmann Associates of Rochester NY, the study investigated the opportunity for, and the willingness of, cities within New York State to improve signal operations under their jurisdiction.

The first major task was to conduct a screening survey of sample cities throughout New York State. Its purpose was to determine which signal system improvements have the greatest potential to maximize benefits during a subsequent deployment program. The screening survey involved interviewing representatives from representative large, medium, and small cities in Upstate New York. Representative cities were defined through a collaborative effort by the study committee. Cities were categorized by the population and number of traffic signals owned and maintained.

Results of the screening survey were utilized as a basis to select cities for in-depth interviews regarding their respective signal systems. Two cities from each group were selected to obtain representative information for a resource inventory. Selection was based on favorable responses to screening survey questions about interest in the follow-up resource inventory and a future program to improve signal operations within their jurisdiction.

Using the resource inventory results, potential costs and savings that would be produced by improving signal timings, coordination, and changing to LED indications were analyzed. The cost evaluation investigated changing red, yellow, and green incandescent bulbs to LED indications, replacing electromechanical controllers with state-of-the-art programmable controllers and retiming traffic signals. The savings analysis covered electrical energy and maintenance for crew savings, along with time, fuel, and accident savings for the general public. Emission reductions were calculated based on shorter idling times and a reduction in gas usage. Environmental benefits include the reduction of Carbon Monoxide (CO), Volatile Organic Compounds (VOx), and Nitrous Oxide (NOx) emissions.

Although not quantified in this initial study, Carbon Dioxide (CO2) emissions from unnecessary idling at traffic lights are also viewed as a significant source of greenhouse
gases; potentially contributing to global warming. CO₂ is called a greenhouse gas because it prevents heat from leaving the earth’s atmosphere, causing the planet’s temperature to warm in the same way glass allows heat to build up in a greenhouse. Recently, a December 2007 report issued by the Congressional Research Service estimated that CO₂ emissions account for 85% of the greenhouse gas emissions in the United States.

Based on the results of this study, there is an evident need for cities and municipalities in Upstate New York to not only upgrade their traffic signal equipment, but also to retime existing signals and where feasible, remove unwarranted traffic signals. In addition to the cost savings for the municipality, improved traffic flow will benefit the traveling public and improve the quality of life for all New York State residents.

For more information, contact: Joe Tario  862-1090 ext. 3215   jdt@nyserda.org

**QUANTUM DOTS AT DOT**

Imagine what you could build if you were able to pick up individual atoms and put them in just the precise spot you wanted? Welcome to the fields of nanoscience and nanotechnology, where distances are measured in nanometers, or one billionth (10⁻⁹) of a meter. In this exciting blend of engineering and chemistry the most common materials have very different properties compared to their microscopic or macroscopic counterparts. Nanoparticles have very large surface areas compared to their volumes, and exhibit a "quantum size effect" – where the electronic properties of solids are altered with the great reduction in particle size.

DOT has teamed with researchers from the State University at Albany to use nanotechnology to tackle a problem that creates delays, increases project expense, impacts worker safety, increases liability, and causes headaches when DOT builds or maintains transportation systems in areas where contaminated soil or ground water are present. Traditionally we collect samples of soil and ground water during design, send these samples to certified laboratories, and receive tables of analytical results listed by chemical name that we use to predict what types of contaminants are present and how far they extend.

When our estimates are off, or when contamination is unexpectedly encountered during construction, we use field instruments known as photoionization detectors (PIDs) or flame ionization detectors (FIDs) to “screen” soil and water for the presence of volatile organic compounds (VOC’s). To obtain lab-certified analytical results and determine whether the volatile contaminant is gasoline, heating oil, dry cleaning fluid or solvents, we quickly scoop samples into small jars, send them off for analysis, and hope the results won’t mean long schedule delays or huge additional costs! In the future the results of this research project may lead to nanotechnology instruments that make accurate, quantitative determinations at the project site in real time.

The goal of Research Project C-02-08 is to use nanotechnology to address this problem by developing an accurate, reliable, durable, portable device that rapidly measures a wide range of contaminants which commonly occur in the transportation environment. The first two years of the project focused on determining if semiconductor nanoparticles known as quantum dots could be “tailored” to detect hydrocarbons associated with petroleum spills; the surfaces of the most promising quantum dots were then modified to distinguish between various contaminant species across a range of concentrations.

During the first year the researchers developed procedures that produced and reproduced large numbers of cadmium selenide (CdSe) quantum dots because their sensitive optical properties changed in response to their chemical environment. A large number of quantum dots in discrete size ranges were synthesized, and then their surfaces were modified by attaching different anchoring molecules called “ligands” that could bind to hydrocarbon compounds. The process was repeated with various types of chemical ligands to identify those best able to sense the chemicals of interest, especially the indicator compounds for gasoline (Continues on page 4.)
Quantum Dots… (Continued from Page 3.)

or “BTEX,” benzene, toluene, ethylbenzene and xylenes. (See Fig. 1)

The second key step was incorporating these quantum dots into a polymer matrix to protect the tiny chemical sensors from oxidation, and also to increase the level of selectivity in the sensing process. A number of polymer hosts were tested to find those that preferentially adsorb the chemical classes of interest. After identifying the best performers, entire “libraries” of quantum dots were deposited into various formulations to create polymer films that were then tested to identify those which enhanced the sensitivity of the system. (See Fig. 2)

The third critical step was to develop and install a micro-testing chamber that would allow nanocomposite films to be set in place as gases containing various concentrations of hydrocarbons were passed over them at controlled pressures and temperatures. A spectrofluorometer was used to analyze the fluorescence of single nanocomposite films. The hydrocarbon response properties of the films were studied by monitoring changes in the intensity of fluorescence of the quantum dots while the gas composition was changed from pure nitrogen (carrier) gas to a hydrocarbon mixture.

The second year of the project focused on adapting the micro-testing chamber to study an array of films containing quantum dots of varied compositions, using different polymer hosts. The work with tailored quantum dot-polymer films to date has demonstrated great promise to increase the sensitivity of these systems to less than 15 parts per million (ppm) for xylenes, and less than 50 ppm for toluene, the “X” and the “T” in BTEX, respectively.

During the coming phases of this project the researchers hope to further tailor the CdSe quantum dots with different surface ligands and different types of matrices that will increase their sensitivity and selectivity towards the target compounds while protecting the quantum dots’ integrity. They hope to expand the target compound testing protocols beyond our BTEX test case and include contaminants such as heating oil, diesel and other fuels. Their work with various substrates have allowed them to create three-dimensional quantum dot “scaffolding” and create parallel “libraries” of sensors and by using different types, thicknesses and concentrations of the polymer hosts.

Ultimately the goal of this research is to create a new generation of portable field instruments that deliver accurate, reliable and precise results for contaminants that occur near highways, bridges, airports, rail lines and ports. This new generation of instruments will revolutionize the ways that environmental contamination is detected, reduce the time and improve the accuracy of determining the types and concentrations of contaminants, and help us more effectively build and maintain transportation systems in historic, industrial and commercial corridors.

For additional information on this project please contact Jeanne Hewitt: jhewitt@dot.state.ny.us
RESEARCH POSTER SESSION

The Transportation Research and Development Bureau hosted its first ever research poster session on December 12, 2007. It was impossible to keep count of how many attended but the room buzzed from the 10:00 AM start till the 2:00 PM end when we had to chase people out, maybe it was the cookies. We selected contract research projects from a variety of program areas for the posters. Thirteen poster stations were set up around the room; several stations covered more than one project. Project managers were on hand to discuss their projects as well as several principal investigators. An Adobe PDF file of the posters and some of the hand out materials is available on the Transportation Research and Development web site, under Technology Transfer.

At the main table we presented the Department’s involvement in national research programs, Transportation Pooled Fund (TPF) projects and the contract research program. We appreciate the feedback we received on the session which was extremely positive. We plan on making this an annual event as long as there is interest. It is not too late to send us comments research@dot.state.ny.us so we can make the next session even better. Special thanks to all those involved in making the session a success.

If you have any questions on the Department’s research program please contact Gary Frederick: gfrederick@dot.state.ny.us

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