UTC Project Information	
Project Title	MPC-420 – Environmentally Benign Extraction of Bitumen from Oil Sands for Pavement Binder
University	University of Utah
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Funding Agencies	USDOT, Research and Innovative Technology Administration
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Project Duration	1 Year
Brief Description of Research Project	Oil sands are an aggregate of clay, sand, water, and bitumen, the last being a black, heavy hydrocarbon solid that is extracted and processed into crude oil (see Oil Shale and Tar Sands Programmatic EIS Information Center). Only Alberta of Canada, the world's largest oil sands deposit, produces oil from oil sands at a significant level, currently over 50% of oil production and increasing. Bitumen can be readily used as a binder for pavement. The largest US oil sands deposit, estimated to contain over 30 billion barrels, resides in Utah and it remains undeveloped. With diminishing light oil supply, increasing oil price, and energy security reasons, oil sands resources have attracted attention. However, development of Utah's oil sands with current hot water extraction technology as practiced in Canada (Misra et al., 1981; Dai and Chung, 1996) will exact a very high cost in environmental quality. Current hot water extraction technology obtains bitumen by contacting excavated oil sands with hot water, which separates the clay and sands and allows the bitumen to float to the water surface. It demands a large amount of water and results in large amounts of tailing and contaminated process water that are very difficult to treat and dispose of in an environmentally acceptable manner. We have provided a more detailed review of oil sands processing and needs recently (Hong et al., 2013). Other solvent-based technologies have been attempted and none have shown to be commercially viable owing to their different sets of barriers. To date, Utah oil sands resource remains virtually untapped. Any new development of the oil sands resource must address critical issues such as cost effectiveness, byproducts of process water and tailings, and water availability especially in arid regions. We have demonstrated a new way of extracting bitumen from Utah oil

	sands (Hong et al., 2013) without using caustics that lead to problematic tailings and contaminated water. We have also shown the incorporation of bitumen as a binder into pavement materials (Hong et al., 2012). The HOSE (heightened oil sands extraction) process involves adding oil sands to hot water in a closed vessel and subjecting the mixture to rapid, successive cycles of pressurization and depressurization with a gas. A pressure cycle begins when air or another gas (e.g., CO_2) is introduced allowing the gas to dissolve in water and the reactor headspace to build to designate pressure (e.g., 100 psi) – the compression stage. Once the specified pressure in the headspace is reached, it is released by venting – the decompression stage. The complete cycle consisting of the compression and the decompression stages is rapidly repeated to a prescribed number of times to achieve release of the bitumen from the sands, typically within 20 min. The process requires no chemical additives and produces high quality and yield of bitumen without the problematic tailings and water. HOSE offers advantages in high bitumen yield (95%), high quality froth (35% bitumen), and low extraction temperature (65 ^{o}C), rapid processing (20 min), and no caustics or other chemicals being used. To deploy HOSE, we must first determine its potential impact on the environment through discharges. We propose here a program to determine the quality of process wastes including the process water and spent sands, the presence of trace organics in wastes, and the recyclability of the water. The water demand and costs will be determined for the new process.
Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	
Impacts/Benefits of Implementation (actual, not anticipated)	
Web Links • Reports • Project Website	