Addressing commercialization challenges for an ex-situ oil shale process by addressing critical mechanical and operational issues

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During the past decade, significant advancement has been made on various recovery technologies to develop U.S. oil shale resources in an environmentally and economically sustainable fashion. Development of unconventional resources, particularly shale gas, oil sands, and shale oil continues to receive substantial attention due to increasing demand for domestic transportation fuels and the need to improve U.S. energy security. Several ex-situ processes have been developed and used to produce syn-crude from oil sands/oil shale including: 1) Hot Water Extraction, (2) External Hot Gas, (3) Indirect Heating and (4) Internal Combustion. Transforming a new ex-situ process from a pilot demonstration project to a fully commercial plant is a major challenge. Addressing the environmental issues (i.e., water usage/ treatment, greenhouse gas emissions, land reclamation, etc.) and process issues (i.e., energy efficiency, net water demand, resource recoverability, etc.) are a main focus in the early development stages. But, most important for commercialization are the mechanical and operational issues that affect on-line reliability and process efficiency (i.e., optimum particle size, control of kiln bed temperature, solids/gas mixing). High yield coupled with uncertain mechanical reliability results in an undefined production profile which prevents the process from being fully commercialized. An example is how best to use the spent shale (sands) residues. Effective use as a road base depends on heavy metal leachability from the de-oiled material. Another requirement for commercialization is a plant wide comprehensive process model that describes the full process. A well validated plant wide process model is required to establish an acceptable economic risk profile for process commercialization. Work presented briefly describes an ex-situ process previously developed by Smoot and co-workers which uses an externally heated horizontal rotary kiln to achieve high recovery yields. The present work focuses on mechanical reliability issues and presents a detailed plant wide model with estimated process economics to support process commercialization.