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Salle 4-014 (zone A), Institut Jean Lamour, Campus Artem

“Scaling down”: investigation of complex industrial processes using lab-scale experiments and CFD simulations

Many industrial, multiphase processes are operated suboptimally, primarily as a consequence of three factors: a lack of process understanding, poor engineering design and insufficient on-line measurements. The end result is a process that performs poorly or unreliably – or both. Trial-and-error attempts to improve the system often give the impression that some intervention (e.g. changing the feed composition) has only a short-lived or intermittent effect. In fact, engineers – who are generally rational human beings – can become superstitious in selecting process operating conditions after a “trial-and-error” field testing program.

In this presentation, a case study involving a once-through-steam-generator (OTSG) used in the enhanced thermal recovery of Canadian heavy oil is considered. In this application, huge quantities of steam must be produced and injected into an oil reservoir to reduce the density and viscosity of the in situ heavy oil so that it can be pumped to the surface. These OTSGs are regularly incapable of producing steam at their specified design rates and often fail (rupture) prematurely. Numerous attempts to improve their operation have provided only limited success. As frustration mounted over the lack of progress, serious and very expensive operational changes were considered, but it was not clear if even such drastic measures would be effective. As a result, a research program involving CFD simulations and lab-scale experiments was conducted to identify the actual mechanisms that limited operation and caused system failures. Carefully conducted CFD simulations provided new insights about the industrial process itself, while lab-scale experiments have produced new information regarding OTSG failure mechanisms. The presentation will explain how the research results are used to develop new, improved design rules and operating envelopes at the industrial scale.