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COSI PI Sneak Peek:

Peek into the World of a Principal Investigator

David Nobes

Hailing from a remote part of Australia, David Nobes did not grow up with the intention of becoming an engineer. People in his community didn't really focus on school marks and going to university was outside the norm. Instead, they focused more on community involvement activities like sports. Following that pattern, after Nobes finished high school he worked for seven years while playing semi-professional Australian Rules Football.

After realizing the unlikelihood of making his sport into a career, Nobes focused on his job. While completing an apprenticeship in fitting and machining he had the opportunity to see what an engineer did. "I thought the interesting part of the job was what the engineer got to do," he explained, "so I took a big change in direction." That change led him to the Engineering program at the University of Adelaide.

After completing his undergraduate degree, Nobes understood from his background experience in the trades that to work in a design capacity he would need a higher-level degree. "Most engineers still tended to be doing a lot of what other people said to do," said Nobes, "and I wanted to get into the other side of things and be involved in the design process, so that was part of my motivation."

Nobes did his PhD on large-scale turbulence and combustion with an application in cement kilns; understanding the mixing field and how a fuel jet mixes with ambient air as part of the combustion process. His research brought about some interesting opportunities, including involvement with the team that designed both the stadium flame and the torches for the 2000 Summer Olympics in Sydney. The problem they were tasked with was to create a "green" or environmentally friendly flame, which would burn incandescently so it was visible to spectators. "It was supposed to be a 'Green Olympics'", Nobes explains, "so we were able to change the mixing process and use natural gas as a clean fuel alternative to get soot to form (to have a radiant flame), but to also have it completely burn out."

Nobes completed his PhD and worked in the United Kingdom for three years, developing optical diagnostic techniques in a post-doctoral position. He then moved to Canada. It was while he was working at an oil sands consulting company in Vancouver that he began to get an understanding of the processes they used to separate and refine oil. "When I came from the consulting company to start my position here [at the University of Alberta]," he says, "it had been my intention to work in the area of the macro-scale turbulent flow problem that I see in the processing of oil sands." Nobes explains that the avenues for starting a new research program were a bit limited and the Centre for Oil Sands Innovation was a place to get started. "I saw the separation of particles from tailings water in [what was] the Aqueous Tailings Theme as a flow problem, which closely aligned with my main interests."

Nobes' project considers separation from a macro, fluid-mechanical point of view. He looks at the feeds or jets of water and oil sands entering a separation vessel: "the concept is that when the jet comes into the vessel it has momentum, that needs to be dissipated and the jet is then just a source of fluid that is being spreading out everywhere. But how do you get it to spread out so that the particles will separate? That got me thinking about which forces are actually present on a particle and what forces we could introduce. At the moment we're trying to use acoustic forces."

His idea is that acoustic forces add a differential pressure across the particle, which leads to a force that would hopefully push particles in a particular direction for separation. "The nice thing about acoustics is that you're not tied to gravity so you can control the direction of the force," he says.

Right now they are focusing their research on tailings, where there is a problem separating fine particles that are staying in suspension. So far they've been able to demonstrate that they can separate at the macro-scale (the size of a coffee cup) using acoustic fields. "We're seeing the particles separate into what we call 'bands'," says Nobes, "but there's a secondary force which pushes the particles together and as the particles get closer together the force gets stronger, which is a little counter-intuitive. The field itself actually gets reverberated between the particles and it sucks them together and when the sound is turned off, they separate."

Although they are making headway with particle separation at a larger scale, it has not come without challenges. The technology to generate the fields of study (a piezo-electric transducer) has only been around for the last 20 years, and fast enough computers and data-acquisition devices have only really been around for the past decade. "The hardware involved is not designed specifically for this. So we're buying hardware and trying to reconfigure it to use for this particular situation," says Nobes.

Even with these technical challenges, Nobes remains positive that his mechanical engineering point of view, combined with COSI's open-minded research perspective, will bring about a new method for separating oil and sand: “there’s a lot of work being done in the chemistry surface properties area, but I look at it as a macro-scale turbulent flow problem, and I don’t see a lot of these challenges being addressed yet. As I see it, the oil and gas industry is extremely conservative and it’s really difficult to get new ideas looked at; you often need a lot of fundamental research to prove that it’s going to work well. I think COSI is great because they provide an opportunity for ideas to be looked at and vetted.”