What's the backscatter of your beer?

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An acoustic technology developed at Pacific Northwest National Laboratory eliminates the need for laborious and costly sampling of slurries in large containers. Fermentation-based industries, such as beer and pharmaceuticals, could benefit from the technology's non-invasive, continuous and objective "listening" technique in tracking microbial growth through the different process phases.

A team of researchers at PNNL can track the size and concentration of particles within opaque slurries by attaching an acoustic-based technology to the outside of a large tank or vat, much like those used to make beer and medicinal drugs.

The lab's patented technique is novel in its fusion of information extracted from both acoustic backscatter and transit measurements, including velocity, amplitude and frequency data.

"The beauty of acoustics is that it can tell you what's going on within a mixture without having to disrupt the process by physically drawing a sample and analyzing it," said Dick Pappas, senior research scientist. "And because we can measure how fast sound travels across a vat, for instance, and the change in the signal's frequency and strength, we can also tell when a mixture has changed from what it should be, possibly heading off a negative situation. Similarly, we can tell when a mixture is brewed to perfection."

Conceptually, this acoustic technology is relatively simple. It consists of either a single transducer or paired transducers – devices that resemble

ear phones and that transform electric signals into sound energy – placed on opposite sides of a container. Both the backscattered acoustic signals and the acoustic signals that transit the vessel contain useful information about the slurry. The signals from the transducers are digitized and analyzed so that an operator can immediately detect changes in the fermentation process. The technology can be automated, runs continuously unattended and can be configured to trigger process controls such as valves and switches.

The ultrasound technology is also useful for measuring cell or organism growth and population in fermentations. A typical method for characterizing fermentation slurries involves diluting and visually counting a sample at periodic intervals. But with acoustics, researchers can quickly and continuously analyze the size and population of organisms throughout the fermentation process, often helping to identify specific fermentation phases.

In addition to biological processes, this backscatter-transit acoustics methodology has been used in lab testing to characterize industrial processes and products such as paints, micro-milling, asphalt-based commercial products and sterilize packaged liquid food.

Source: Pacific Northwest National Laboratory