HIELSCHER : Ultrasonic Disintegration of Cell Structures

Ultrasonication is an effective means to break cell structures. This effect can be used for the extraction of intracellular materials, e.g. starch from the cell matrix.

Ultrasonication generates alternating high-pressure and low-pressure waves in the exposed liquid. During the low-pressure cycle, the ultrasonic waves create small vacuum bubbles in the liquid that collapse violently during a high-pressure cycle. This phenomenon is termed **cavitation**. The implosion of the cavitation bubble causes **strong hydrodynamic shear-forces**.

The shear forces can **disintegrate fibrous, cellulosic material** into fine particles and break the walls of the cell structure. This **releases more of the intra-cellular material**, such as starch or sugar into the liquid. In addition to that the cell wall material is being broken into small debris.

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This effect can be used for **fermentation**, **digestion** and other conversion processes of organic matter. After milling and grinding, ultrasonication makes more of the intra-cellular material e.g. starch as well as the cell wall debris **available to the enzymes** that convert starch into sugars. It does also **increase the surface area** exposed to the enzymes during liquefaction or saccharification. This does typically **increase the speed and yield** of yeast fermentation and other conversion processes, e.g. to **boost the ethanol production** from biomass.

Ultrasonic disintegration can be easily tested in **any scale**:

- lab scale for 1mL to approx. 5L
  e.g. UP400S with 22mm sonotrode
- bench top scale at approx. 0.1 to 20L/min
  e.g. UIP1000hd with 34mm sonotrode and flowcell
- production scale starting at 20L/min
  e.g. UIP4000 or UIP16000