

Acetogen

Cellulosic biomass is made up of cellulose and hemicellulose along with lignin and ash (minerals). Cellulosic materials are difficult to break down and require either a new class of enzymes or chemical fractionation using a dilute acid.

In the ZeaChem hybrid process, a naturally occurring acetogen is used. Acetogens have several advantages compared to yeast, which is used in most other fermentation stages: acetogens convert all xylose (C₅) and glucose (C₆) sugars and tolerate all breakdown products of biomass, they operate in harsh environments, and they produce no CO₂. Acetogens have found competitive niches in many natural environments such as freshwater and marine sediments, deep subsurface sediments associated with oil fields, sewers, anaerobic digesters, and the gastrointestinal tracts of termites, cockroaches, ruminants, and monogastric animals including humans. The acetogens are able to compete in these environments because of the remarkably diverse range of substrates they are able to consume.

The metabolic diversity of acetogens is especially useful when considering ethanol production from cellulosic biomass. Naturally occurring acetogens are capable of simultaneously converting both xylose and glucose sugars. In contrast, naturally occurring organisms for direct ethanol fermentation, such as yeast, either cannot handle a mixed carbohydrate source or require genetic engineering enhancements. Traditional yeast cannot ferment xylose so most biochemical processes either require a duplicate fermentation train to convert the xylose or the creation of yeast that can convert both xylose and glucose sugar streams.

In the ZeaChem fermentation process, the acetogen turns the biomass sugar molecules into acetic acid. Acetogens have the unique ability to produce acetic acid from sugars at up 100% carbon efficiency and produce no CO₂ during fermentation. A 50% higher fermentation yield translates into lower costs and the acetogen platform can produce multiple products such as bio-based fuels and chemicals.