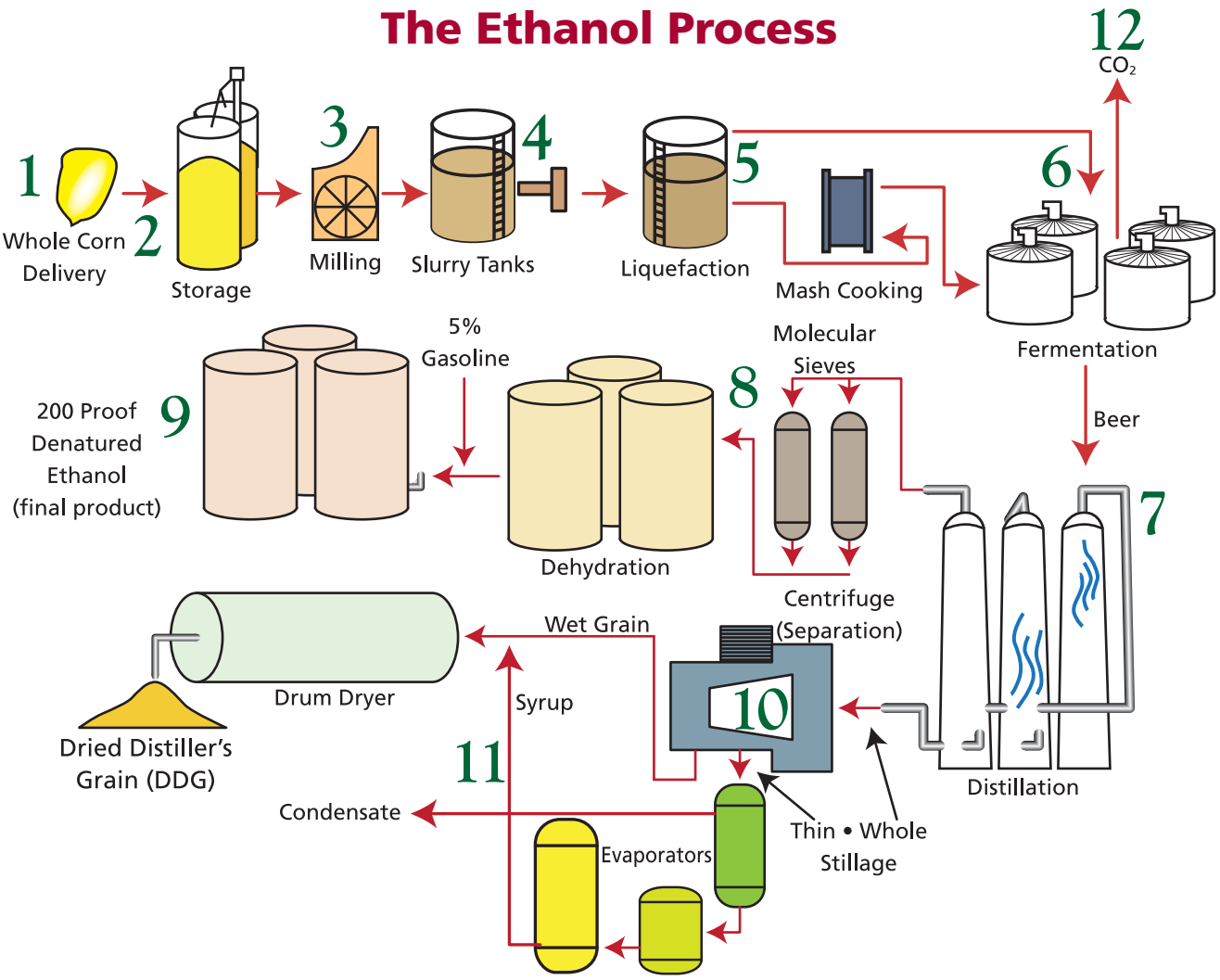
# Ethanol Production

HOFFMAN LAMSON

## The Ethanol Process




**1 Grain Delivery**
via truck and rail.

**2 Grain Handling**
Enough corn to supply the ethanol plant for 10 days is loaded into storage structures.

**3 Grain Milling**
Cleaned corn is transferred to a surge tank where the corn is fed into grinders and the resulting "flour" is stored in a day tank.

**4 Slurry Tanks**
Flour is transferred from the grain milling operation to a mixer and is mixed with water and enzymes to form a slurry.

**5 Liquefaction**
The slurry is held in liquefaction tanks to enable enzymes time to break down the starch into fermentable sugars.

**6 Fermentation**
Yeast is added to the mash to ferment the sugars to ethanol and carbon dioxide.

**7 Distillation**
The fermented mash, now called beer, contains about 10% alcohol plus all of the non-fermentable solids from the corn and yeast cells. The mash is pumped to the continuous flow, multi-column distillation system where the alcohol is removed from the solids and the water. The alcohol leaves the top of the final column

at about 95% strength and the residue mash, called stillage, is transferred from the base of the column to the co-product processing area.

**8 Dehydration**

The ethanol contains 5% water (hydrous ethanol) and runs through molecular sieves to remove the remaining water molecules, resulting in anhydrous ethanol (pure, without water) - which is approximately 200 proof.

**9 Denaturing**

Ethanol that will be used for fuel must be denatured, or made unfit for human consumption, with a small amount of gasoline (2-5%). This is done at the ethanol plant.

**10 Separation**

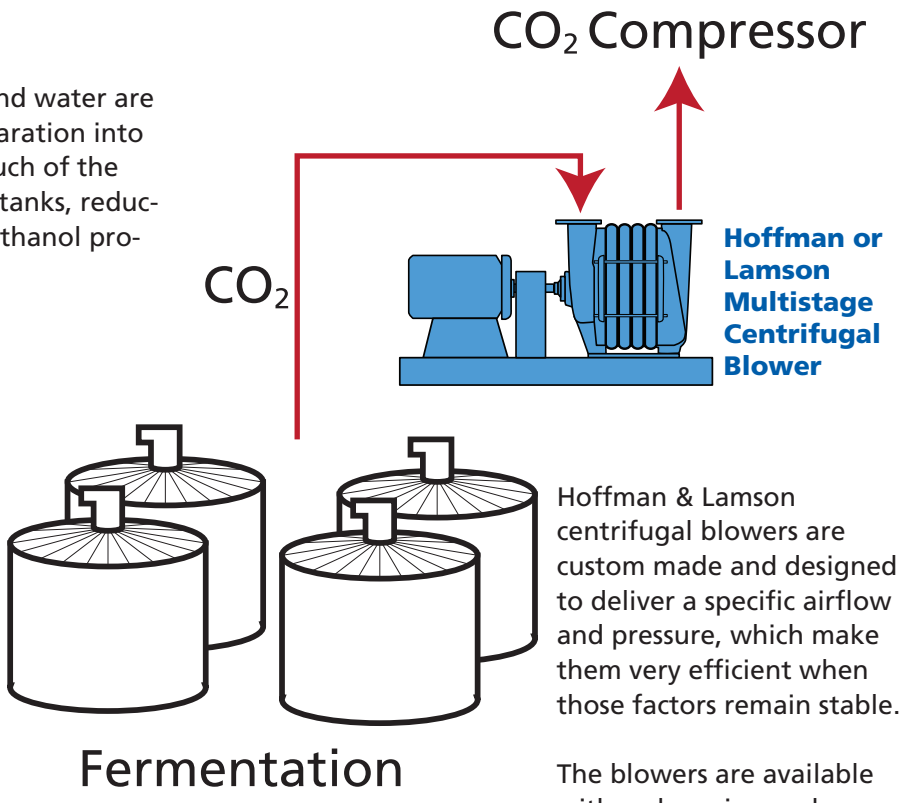
The solids from the distillation column and water are transferred through a centrifuge for separation into thin stillage and wet distillers grains. Much of the thin stillage is recycled back to the surry tanks, reducing the volume of water needed in the ethanol production process.

**11 Dried Distiller's Grain (Co-Product)**

The wet distillers grains are often sent through dryers, producing a valuable and high-protein feed ration for livestock.

**12 $CO_2$ (Co-Product)**

Carbon dioxide is given off during the fermentation stage of ethanol production and some ethanol plants collect the carbon dioxide and market it. To do this, the gas must be removed and stored under pressure. **A multistage centrifugal blower may be used as an exhauster to draw off the $CO_2$ and transport it to a compressor for storage in pressurized cylinders.**




Hoffman & Lamson centrifugal blowers are custom made and designed to deliver a specific airflow and pressure, which make them very efficient when those factors remain stable.

The blowers are available with carbon ring seals, which are well suited to $CO_2$ applications. They are also quieter than positive displacement blowers when used without an enclosure.

**General Housekeeping**

Ethanol facilities may use a robust vacuum stystem to keep the receiving and storage areas clean of raw stock.

As a supplier of engineered central vacuum systems, Hoffman & Lamson can create a housekeeping system to keep the plant free of combustible dust and let it meet OSHA standards.

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