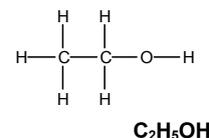




MAKING ETHANOL

Ethanol is found in alcoholic drinks and is used as a solvent to make many common substances such as detergents and pharmaceuticals. It can also be used as a fuel. In some countries, such as Brazil, it is used as fuel for cars. It is a biofuel because it is made from plants that are renewable.



Over 90% of the world's ethanol is produced from crops such as sugar cane, sugar beet, corn, rice and maize. This is done by fermentation. These are renewable raw materials because we can grow more to replace those which have been used. The ethanol made by fermentation is not pure, it also contains water. Fractional distillation is used to make pure ethanol from the mixture.

The other main method of producing ethanol is by reaction of ethene with steam. Ethene is made from crude oil which is a non-renewable source meaning that it cannot be replaced when we use it. However, the ethanol produced this way is pure.

	Fermentation of carbohydrates	Reaction of ethene with steam
Equation		
Conditions	Temperature = Pressure = Catalyst = Other =	Temperature = Pressure = Catalyst =
Raw materials		
Raw material type		
Type of process		
Reaction rate		
Purity of ethanol		

Which method for producing ethanol:

	fermentation	hydration of ethene
a) is fastest?		
b) uses renewable raw materials?		
c) takes place at lower temperatures and pressures?		
d) gives purer ethanol?		
e) is a continuous process?		
f) has lower labour costs?		

"Carbon neutral"?

One of the great advantages of using ethanol as a fuel, besides it being renewable, is that it is regarded as being "carbon neutral". By this we mean that it releases the same amount of CO₂ when it is burned as was taken in from the atmosphere when the plants grew and photosynthesised.

Photosynthesis in crops	$6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{H}_2\text{O}$	uses up 6CO ₂
Fermentation to make ethanol	$\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}_2$	
Burning ethanol	$2\text{C}_2\text{H}_5\text{OH} + 6\text{O}_2 \rightarrow 4\text{CO}_2 + 6\text{H}_2\text{O}$	
Overall for fermentation + burning	$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$	overall releases 6CO ₂

However, in the process of going from crop to using the fuel, there are other processes to consider including fuel for machinery and transport meaning that it is not 100% carbon neutral. Plus, there are growing concerns that too much agricultural land is being used for growing crops to make biofuels rather than food