

Tech Connect: The Breathalyzer

Drinking and driving continues to be a serious problem everywhere in the world. There are over 1000 deaths each year in Canada alone, as a result of alcohol-related motor vehicle crashes. Drunk drivers must be taken off the roads, but how do law enforcement officers determine that a driver is drunk? One way is to have drivers suspected of being drunk pass simple roadside sobriety tests, such as touching their nose or walking a straight line. These tests are not always reliable, however. People who have been drinking may be able to walk a reasonably straight line, but they may not have the fine motor skills or be able to make the quick judgments needed to drive a car safely. Their muscle movements and thought processes may be impaired. Thus, police officers use technological devices to measure the concentration of alcohol in a driver's blood. If the alcohol concentration is equal to or exceeds a certain value, the driver is arrested.

Alcohol (ethyl alcohol, or ethanol) intoxication is legally defined by the blood alcohol concentration (BAC). Asking a driver to give a blood sample or a urine sample in the field for later analysis in a laboratory is not practical or efficient. Fortunately, the alcohol that a person drinks appears in the breath at a concentration that is proportional to the alcohol's concentration in the bloodstream. As the blood moves through the lungs, some of the alcohol passes into the lung's air sacs (alveoli) by diffusion. Instead of drawing blood to test alcohol concentrations, a police officer can test a driver's breath using a portable device called a Breathalyzer.

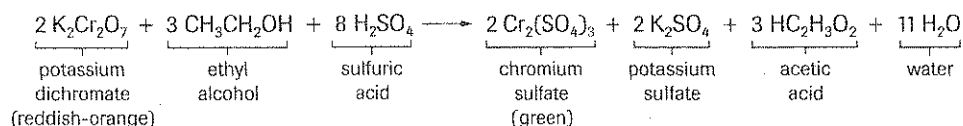
The average ratio of breath alcohol to blood alcohol is 2100:1. Thus, 2100 mL of alveolar air contains the same amount of alcohol as 1 mL of blood. In Canada, the legal standard for drunkenness is a BAC of 0.08 g/100 mL or greater. This value means that there is 0.08 g of ethyl alcohol per 100 mL of blood, most often expressed as 0.08% W/V.

How the Breathalyzer Works

The Breathalyzer contains three main parts:

1. a part that allows a suspect to blow a sample of exhaled air into the system
2. two glass vials containing a mixture of chemicals that change in colour when they react with alcohol
3. a part that measures the colour change associated with the chemical reaction and converts the measurement to a BAC that appears on a digital readout or analogue meter

The Breathalyzer measurement is based on the following chemical reaction:



During this reaction, the reddish-orange dichromate ion changes to the green chromium ion when it reacts with ethyl alcohol in a driver's breath. The degree of colour change is directly related to the concentration of ethyl alcohol in the expired air. There are two vials in the Breathalyzer because the colour of the reacted solution is compared with the colour of an unreacted solution. A system of colour-sensitive photocells detects the difference in colour and produces the electric current that causes the needle on the meter to move. The police officer rotates a knob to bring the

needle back to its resting place and reads the level of alcohol from a scale on the knob. The more the police officer needs to turn the knob to return it to its resting position, the greater is the alcohol concentration in the reacted sample.

Questions

- Describe two simple tests that a police officer can use to determine whether a driver has had too much alcohol to drink.
 - Why may these tests be unreliable?
- What does the concentration of alcohol in the breath represent?
 - Why can BAC be used as a measure of the concentration of alcohol in the bloodstream?
- What is the legal standard for drunkenness in Canada?
- List and describe the three main parts of a Breathalyzer.
 - Describe how the parts of a Breathalyzer work to determine the BAC.
- Using print and/or electronic resources, research answers to the following questions about devices that measure BAC:
 - Who invented the first portable device for measuring BAC? When was this device invented?
 - The Intoxilizer has been approved by the Canadian government for legally measuring BAC. How does the Intoxilizer differ from the Breathalyzer?
 - Identify one other device that has been developed for measuring BAC.



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