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Bomb calorimeter

A bomb calorimeter is one type of the constant-volume calorimeters employed in gauging the heat of combustion of a certain reaction. Bomb calorimeters are designed to withstand the large pressure that builds within the calorimeter as the reaction is being gauged. Electrical energy is the one that is used to ignite the fuel. As the fuel burns, the rise in temperature heat up the surrounding air, which increases in volume as a result of expansion and finds its way out through a tube that, leads the escaping air out of the calorimeter. When the air escapes via a copper tube, its temperature also heats up the water surrounding the tube. It is the temperature of the heated water as a result of escaping air that allows one to calculate the calorie content of the fuel (Brown 30). The information gathered from a bomb calorimeter during a chemical reaction tells scientists whether certain products are safe for use and the quality level of each product being tested. The paper discusses the bomb calorimeter operation procedure and its use in practice.

Operation procedure

i. Starting the bomb calorimeter

Operation of a bomb calorimeter requires observance of specific steps in starting and shutting down the instrument. The procedures of starting it include starting the timer as well as recording the temperatures after stirring for five minutes, recording the temperatures at an interval of one minute for next five minutes, standing back from bomb calorimeter for about 30 seconds and firing the bomb by switching on the ignition button and holding it that way until the indicator light goes off. Recording the readings on the thermometer at a 20 second interval until the temperature becomes constant and finally switching off the stirrer driver along apparatus after the temperature has become constant ("Standard Operating Procedure and Safety Guide for Bomb Calorimeter" 26).

ii. Shutting the bomb calorimeter

After shutting off the stirrer drive motor, one is required to first remove the drive belt from the cover of the calorimeter, to remove the cover, to wipe the thermometer and stirrer by aid of a clean cloth and placing the cover in upright position. However, it will be very essential for to ensure the electrical supply to the ignition is terminated before lifting the bomb from the bucket. Leads are then removed from the bomb which is cleaned with a clean cloth ("Standard Operating Procedure and Safety Guide for Bomb Calorimeter" 26).

To do away with entrainment losses, gases are released from the bomb gradually for about one minute. After all pressure has been released, the bomb head is released and placed in upright position. The interior surface of the bomb is then washed and cleaned. Finally, the bomb, washers and the bucket that was used are washed.

Thermodynamics use

Bomb calorimeters are essentially and actively used in the scientific studies of thermodynamic processes (Black). They measure the heat of explosion detected in a reaction of chemical elements, as well as reaction enthalpy, heats involved in formation and reaction, and change in enthalpy through it.

Fuel testing

Bomb calorimeters are used in testing the calorific value of solid as well as liquid fuels, which are traded based on the respective value. Fuels such as coal and oil must meet regulations specifying the total calorific value, quality and purity of the fuel (Black). Liquid fuels like gasoline and kerosene are also tested by bomb calorimeters. The measure of energy give-off by the fuel is determined by the fuel's heat of combustion.

Waste and refuse disposal

The cement industry is one of the industries that use hazardous waste as an alternative fuel. However, the process is regulated by the governmental organizations, including the Environmental Protection Agency (EPA) (Black). Bomb calorimeter is used to determine whether hazardous waste fuel meets those regulations and is safe and appropriate for use.

Metabolic studies

Bomb calorimeters can be used to determine the calorie content of a product. This process is used in food and metabolic studies to examine the effects of energy content in food on humans and animals (Black). These studies have implications that extend into nutritional considerations and health concerns regarding the effects of diet on the body.

Propellant and explosive testing

Propellants and explosives are tested using a bomb calorimeter to find each product's heat of detonation (Black). Propellants typically burn predictably at a steady rate, while explosives are unstable and exert a huge amount of pressure with the induction of the chemical reaction — information about both of these processes are identified with bomb calorimeters.

In conclusion, bomb calorimeters are irreplaceable in many fields of activity including thermodynamics, fuel testing, waste disposal, metabolic studies and explosive training. Their main function is to provide the scientists with the information whether the product is safe to use and its effect on people.

Works Cited

Black, Ashley. *Uses of a Bomb Calorimeter*. Sciencing, 25 Apr. 2017, sciencing.com/uses-bomb-calorimeter-8062648.html. Accessed 08 May 2017.

Brown, Michael. *Handbook of Thermal Analysis and Calorimetry: Principles and Practice*. *Volume 1 of Handbook of Thermal Analysis and Calorimetry*. New York: Elsevier, 1998. Print.

"Standard Operating Procedure and Safety Guide for Bomb Calorimeter." 2010. Web. October 8, 2014. <http://www.unb.ca/fredericton/engineering/depts/mechanical/_resources/pdf/sop/bomb-calorimeter.pdf>