

Demonstration of the Process of Combustion by Paintings

Abraham Tamir*

Department of Chemical Engineering, Ben-Gurion University of the Negev, Beer-Sheba, Israel

Combustion or burning is the sequence of exothermic chemical reactions between a fuel and an oxidant accompanied by the production of heat and conversion of chemical species. The release of heat can produce light in the form of either glowing or a flame. This process supplies most of the energy required by human civilization. Some accepted definitions of combustion are: 1. The process of burning. 2. Any process in which a substance reacts with oxygen to produce a significant rise in temperature and the emission of light. 3. A chemical process in which two compounds, such as sodium and chlorine, react together to produce heat and light. 4. A process in which a compound reacts slowly with oxygen to produce little heat and no light.

Probably the earliest reasonably scientific attempt to explain combustion was that of Johannes Baptista van Helmont (1580-1644), a Flemish physician and alchemist. He observed the relationship among a burning material, smoke and flame and said that combustion involved the escape of a "wild spirit" from the burning material. In 1667 Johann Joachim Becher (1635-1682), a German alchemist and physician, proposed the phlogiston theory. According to it there exist a fire-like element called "phlogiston" that is contained within combustible bodies and are released during combustion. It was the great French chemist Antoine Laurent Lavoisier (1743-1794) who rejected traditional thinking and framed a new definition of combustion that was widely accepted. Combustion, he said, is the process by which some material combines with oxygen. And finally the phenomenon of fire is mentioned already in the Bible in Genesis 15:17 as follows: "When the sun had set and darkness had fallen, a smoking firepot with a blazing torch appeared and passes between the pieces".

In the following combustion is presented via artworks. Figure 1 demonstrates practical application of combustion to burners used in domestic and outdoors gas stoves. The regular burner and its flame are shown on the top of the figure. Due to the arrangement of the holes in the burner that are turning outside, the flame is also turning outside. In 1990 the first author developed an efficient gas burner in which the holes are turning to the center of the burner and are located at some angle with respect to the radius of the burner. In this year, the largest manufacturer of camping equipment in Israel launched

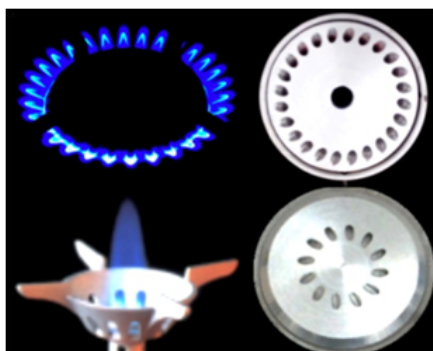


Figure 1: Combustion.

the market with a new product, the *Roto flame Camping Cooker*. The burner and its flame are shown at the bottom of Figure 1 where its flame is concentrated and rotating. The stove based on it has the following characteristics: 1) Thermal efficiency is higher by 20-25% than regular burners. 2) Boiling of water is accelerated considerably. 3) Due to rotation of the flame, mixing with air is better, thus reducing air pollution. The Polish surrealist artist Jacek Yerka (1952) painted Figure 2 entitled "Eruption" that demonstrates combustion inside a big hole of a mountain. The Belgium surrealist artist Rene Magritte (1898-1967)



Figure 2: Eruption.



Figure 3: The Discovery of Fire.

*Corresponding author: Abraham Tamir, Department of Chemical Engineering, Ben-Gurion University of the Negev, Beer-Sheba, Israel, E-mail: atamir4@012.net.il

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painted Figure 3 entitled “The Discovery of Fire” and Figure 4 (right-hand-side) entitled “Portrait of Edward James”. In order to emphasize the effect of combustion in artwork the authors changed the color from yellow to red in Figure 4 (left-hand-side). Figure 5 is a surrealist artwork, “The Fire”, painted by Giuseppe Arcimboldo (c.1530-1593), Mannerism Italian painter. Figure 6 entitled “Whaaaam” demonstrates combustion due to firing of the enemy by an aircraft. Roy Lichtenstein (1923-1997), an American pop artist, painted it. Rudolph Ackerman (1764-1834) an Anglo-German bookseller, inventor and lithographer painted Figure 7 entitled “Fire in London”. Figure 8 entitled “Funky Fire” demonstrates a surrealist fire giving an impression of a terrible combustion. Figure 9 demonstrates a surrealist “Atomic Bomb Tree” artwork associated with fire. Figure 10 is another surrealist artwork of fire entitled “Sacred Fire of Pele, Goddess of Hawaii Volcano” that is located in the Hawaiian Art Gallery by Olga Schevchenko. In

Figure 11 an interesting surrealist folding fire is presented where our demonstrations are terminated by the impressive artwork of Magritte entitled “The Gradation of Fire”. In conclusion the authors believe that the artistic demonstrations of combustion gives to this phenomenon a wider view and it becomes more attractive to the viewer.



Figure 4: Portrait of Edward James.



Figure 5: The Fire.



Figure 6: Whaaaam.



Figure 7: Fire in London.



Figure 8: Funky Fire.



Figure 9: Atomic Bomb Tree.



Figure 10: Sacred Fire of Pele.



Figure 11: The Gradation of Fire.