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Note on RECENT TECHNOLOGIES

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Innovative way to develop fire extinguisher

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Abstract: Fire is one of the main concerns of the plant safety for an industry. Industries have fire code which is generally a set of rules prescribing minimum requirements to prevent fire and explosion hazards arising from storage, handling, or use of dangerous materials, or from other specific hazardous conditions. In this paper we have studied various reactions which can be used to produce carbon dioxide also we have done the basics of design of the fire ball extinguisher which can be thrown from a distance. We have calculated various parameters like the reaction time, enthalpy, and other chemical properties.This extinguisher will save lives of the many firemen who lose their lives due to these accidents.

Keywords: Extinguisher, Fire safety, Ball type Extinguisher

1. INTRODUCTION

Fire safety is an important workplace topic throughout the year. While death and injury are the greatest risks and the ones with which most people are familiar, fires also destroy jobs. In fact, many of the workplaces that are destroyed by fire are never rebuilt. An Industrial fire is a type of industrial disaster involving a conflagration which occurs in an industrial setting. Industrial fires often, but not always, occur together with explosions. They are most likely to occur in facilities where there is a lot of flammable material present. Such material can include petroleum, petroleum products such as petrochemicals, or natural gas. There are two main types of fire extinguishers: stored-pressure and cartridge-operated. In stored pressure units, the expellant is stored in the same chamber as the firefighting agent itself. Depending on the agent used, different propellants are used. With dry chemical extinguishers, nitrogen is typically used; water and foam extinguishers typically use air. Stored pressure fire extinguishers are the most common type. Cartridge-operated extinguishers contain the expellant gas in a separate cartridge that is punctured prior to discharge, exposing the propellant to the extinguishing agent.

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1.1. Types of Fires

Not all fires are the same. Different fuels create different fires and require different types of fire extinguishing agents.
Class A-Class A fires are fires in ordinary combustibles such as wood, paper, cloth, trash, and plastics.
Class B-Class B fires are fires in flammable liquids such as gasoline, petroleum oil and paint. Class B fires also include flammable gases such as propane and butane. Class B fires do not include fires involving cooking oils and grease.
Class C-Class C fires are fires involving energized electical equipment such as motors, transformers, and appliances. Remove the power and the Class C fire becomes one of the other classes of fire.
Class D-Class D fires are fires in combustible metals such as potassium, sodium, aluminum, and magnesium.
Class K-Class K fires are fires in cooking oils and greases such as animals fats and vegetable fats.

1.2. Types of fire extinguishers available

Water and Foam
Water and Foam fire extinguishers extinguish the fire by taking away the heat element of the fire triangle. Foam agents also separate the oxygen element from the other elements.[16] Water extinguishers are for Class A fires only - they should not be used on Class B or C fires. The discharge stream could spread the flammable liquid in a Class B fire or could create a shock hazard on a Class C fire.

Carbon Dioxide
Carbon Dioxide fire extinguishers extinguish fire by taking away the oxygen element of the fire triangle and also be removing the heat with a very cold discharge. Carbon dioxide can be used on Class B & C fires. They are usually ineffective on Class A fires.

Dry Chemical
Dry Chemical fire extinguishers extinguish the fire primarily by interrupting the chemical reaction of the fire triangle. Today's most widely used type of fire extinguisher is the multipurpose dry chemical that is effective on Class A, B, and C fires. This agent also works by creating a barrier between the oxygen element and the fuel element on Class A fires. Ordinary dry chemical is for Class B & C fires only. It is important to use the correct extinguisher for the type of fuel! Using the incorrect agent can allow the fire to re-ignite after apparently being extinguished successfully.

Cartridge Operated Dry Chemical
Cartridge Operated Dry Chemical fire extinguishers extinguish the fire primarily by interrupting the chemical reaction of the fire triangle. Like the stored pressure dry chemical extinguishers, the multipurpose dry chemical is effective on Class A, B, and C fires. This agent also works by creating a barrier between the oxygen element and the fuel element on Class A fires. Ordinary dry chemical is for Class B & C fires only. It is important to use the correct extinguisher for the type of fuel! Using the incorrect agent can allow the fire to re-ignite after apparently being extinguished successfully.

Fire ball extinguisher
This is a carbon dioxide type fire extinguisher which can be used for B and C type of fires. This extinguisher works either using chemical reactions or by using the carbon dioxide released by the industries. The selection of the reactions to be used was done by finding out the effect of various parameters like quantity of carbon dioxide produced, reaction time and impact on surrounding.

3. METHODS AND PROCEDURE

We have studied three reactions which can be used in the fire extinguisher.
Sulphuric acid and sodium bicarbonate reaction
$2NaHCO_3 + H_2SO_4 \rightarrow Na_2SO_4 + 2CO_2 + H_2O$

Aluminium Sulphate and sodium bicarbonate

$Al_2(SO_4)_3 + 6 NaHCO_3 = 3 Na_2SO_4 + 2Al(OH)_3 + 6 CO_2$

Acetic acid and Sodium carbonate
$CH_3COOH + Na_2CO_3 \longrightarrow 2 CH_3COONa + H_2O + CO_2$

In the next section calculations are done followed by tabulation of the values.

3.1. Calculations

For the Reaction of Sulphuric acid and Sodium bicarbonate

$2NaHCO_3+H_2SO_4 = Na_2SO_4 + 2H_2O + 2CO_2$

Weight of $NaHCO_3$ taken 168gms Volume of H_2SO_4 taken 53.26 cm3

Calculation-
*No of moles = weight/molecular weight Weight =moles×molecular weight
=2×84
Weight =168 gms of $NaHCO_3$

*Volume of sulphuric acid

No of moles = weight/molecular weight Mass = moles×molecular weight
= 1×98 Mass
=98gms

Density = 1.84 gm/cm3

Volume = mass/density
98/1.84
53.26 cm3

Enthalpy Calculation

$\Delta H(NaHCO_3) = -947.68$ Kj/mol
$\Delta H(H_2SO_4) = 1295.23$ Kj/mol
$\Delta H(CO_2) = -393.51$ Kj/mol
$\Delta H(H_2O) = -241.82$ Kj/mol
$\Delta H(Na_2SO_4) = -1387.1$ Kj/mol

$\Delta H® = \Delta H(\text{reactants}) - \Delta H(\text{products})$
$= (2(-393.51)+2(-241.82)+(-1387.1)) - (2(947.68)+1295.23)$
$= -2057.63$ Kj/mol

$\Delta H = -2057.63$ Kj/mol

Entropy Calculation

$\Delta S(NaHCO_3) = 102$ j/mol k
$\Delta S(H_2SO_4) = 2392$ j/mol k
$\Delta S(CO_2) = 219$ j/mol k
$\Delta S(H_2O) = 69.95$ j/mol k
$\Delta S(Na_2SO_4) = 149.6$ j/mol k

TABLE 1
CALCULATED PARAMETERS

Reactant	Products	Amount of heat released	Entropy	Amount of CO2
Acetic acid, Sodium bicarbonate	Carbon dioxide, Water, Sodium Acetate	1282.96 Kj/Mol	-2509.9 J/Mol K	264 gms
Sulphuric acid, Sodium bicarbonate	Carbon dioxide, Water, Sodium sulphate	-2057.63 Kj/Mol	366.54 J/Mol K	88Gms
Aluminum Sulphate, Sodium bicarbonate	Aluminium hydroxide, Carbon dioxide, Sodium sulphate	67.72 Kj/Mol	-1139.4 J/Mol K	264 Gms

$\Delta S®=\Delta S(\text{reactans})-\Delta S(\text{products})$
$=(2(219)+2(69.95)+149.64)-(2(102)+157)$
$=366.54$ j/mol k

$\Delta S=366.54$ j/mol k

In the similar manner calculations were conducted for the other two reactions. The reaction which produces the maximum amount of carbon dioxide is preferred. Although the reaction with concentrated sulphuric acid is hazardous in nature which restricts its use as an chemical in the fire extinguishers. The aluminium sulphate reactions will produce carbon dioxide along with the foam.

4. CONCLUSION

Our proposed method is just an innovative way to use an fire extinguisher. The chemical reaction used are studied and analysed by finding various factors by heat released, quantity of carbon dioxide produced, etc. The alternative method of using the produced carbon dioxide of industries for there own safety. This method we are constantly studying and finding better way to reduce the cost of this method so that it can be economically feasible.