



SNS COLLEGE OF TECHNOLOGY

Vazhiampalayam, Coimbatore-35

(An Autonomous Institution)

Accredited by NAAC with A++ grade 3rd cycle, Accredited by NBA
Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai



IGNITION TEMPERATURE, EXPLOSIVE TEMPERATURE





CONTENTS

- INTRODUCTION TO IGNITION TEMPERATURE
- SPONTANEOUS IGNITION TEMPERATURE
- EXPLOSIVE RANGE OR LIMITS OF INFLAMMABILITY





INTRODUCTION

Ignition temperature

- Ignition temperature is defined as, “the lowest temperature to which the fuel must be heated, so that it starts burning smoothly”
- Ignition temperature of coal is about 300°C
- In the case of liquid fuels, the ignition temperature is called the flash point, which ranges from $200 - 450^{\circ}\text{C}$
- For gaseous fuels, the ignition temperature is in the order of 800°C .



INTRODUCTION

Spontaneous Ignition Temperature (SIT)

- Spontaneous Ignition Temperature is defined as “the minimum temperature at which the fuel catches fire (ignites) spontaneously without external heating”
- If the ignition temperature of a fuel is low it can catch fire very quickly
- On the other hand if the ignition temperature is high it is difficult to ignite the fuel
- If the heat evolved in a system is unable to escape, temperature of the system goes on increasing and when SIT is reached, the system burns on its own.



Explosive range or limits of inflammability

Explosive range or limits of inflammability

- All gaseous fuels have two limits called upper limit and lower limit. These limits represents percentage by volume of fuel present in fuel-air mixture.
 1. Lower limit represents the smallest proportion of combustible gas
 2. Upper limit represents the largest proportion of combustible gas.
- The range covered by these limits is termed as explosive range of the fuels
- For continuous burning the amount of fuel present in the fuel-air mixture should not go below the lower limit or above the upper limit.



Explosive range or limits of inflammability

- The explosive range of petrol is 2-4.5
- This means that when the concentration of petrol vapour in petrol-air mixture is between 2 and 4.5 by volume, the mixture will burn on ignition
- When the concentration of petrol vapour in petrol-air mixture is below 2% (lower limit) or above 4.5% (upper limit) by volume, the mixture will not burn on ignition
- Some of the limits of inflammability are given in the following table.



Explosive range or limits of inflammability

The limits of inflammability of hydrogen, acetylene, natural gas

Gas	Lower limit of inflammability	Upper limit of inflammability
Hydrogen	4	74
Acetylene	3	80
Natural gas	5	14

Thus, explosive range (or) explosive limit is the limiting composition of a gas-air mixture beyond which the mixture will not ignite and continue to burn is called explosive range (or) explosive limit.



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FLUE GAS ANALYSIS





Flue gas analysis

Flue gas analysis (Orsat method)

- The mixture of gases (like CO_2 , O_2 , CO , etc) coming out from the combustion chamber is called flue gases
- The analysis of a flue gas would give an idea about the complete or incomplete combustion process
- The analysis of flue gases is carried out by using Orsat's apparatus.



ORSAT'S METHOD

ORSAT'S APPARATUS

- Orsat's apparatus consists of a horizontal tube
- At one end of this tube, U-tube containing fused CaCl_2 is connected through 3-way stop cock
- The other end of this tube is connected with a graduated burette
- The burette is surrounded by a water-jacket to keep the temperature of gas constant
- The lower end of the burette is connected to a water reservoir by means of a rubber tube



ORSAT'S METHOD

- The level of water in the burette can be raised or lowered by raising or lowering the reservoir.
- The horizontal tube is also connected with three different absorption bulbs 1, 2, and 3 for absorbing CO_2 , O_2 and CO .

Bulb	Reagent	Function
1	Potassium hydroxide solution.	Absorbs only CO_2
2	Alkaline pyrogallol solution.	Absorbs CO_2 and O_2
3	Ammoniacal cuprous chloride solution.	Absorbs CO_2 , O_2 and CO



ORSAT'S METHOD

Working

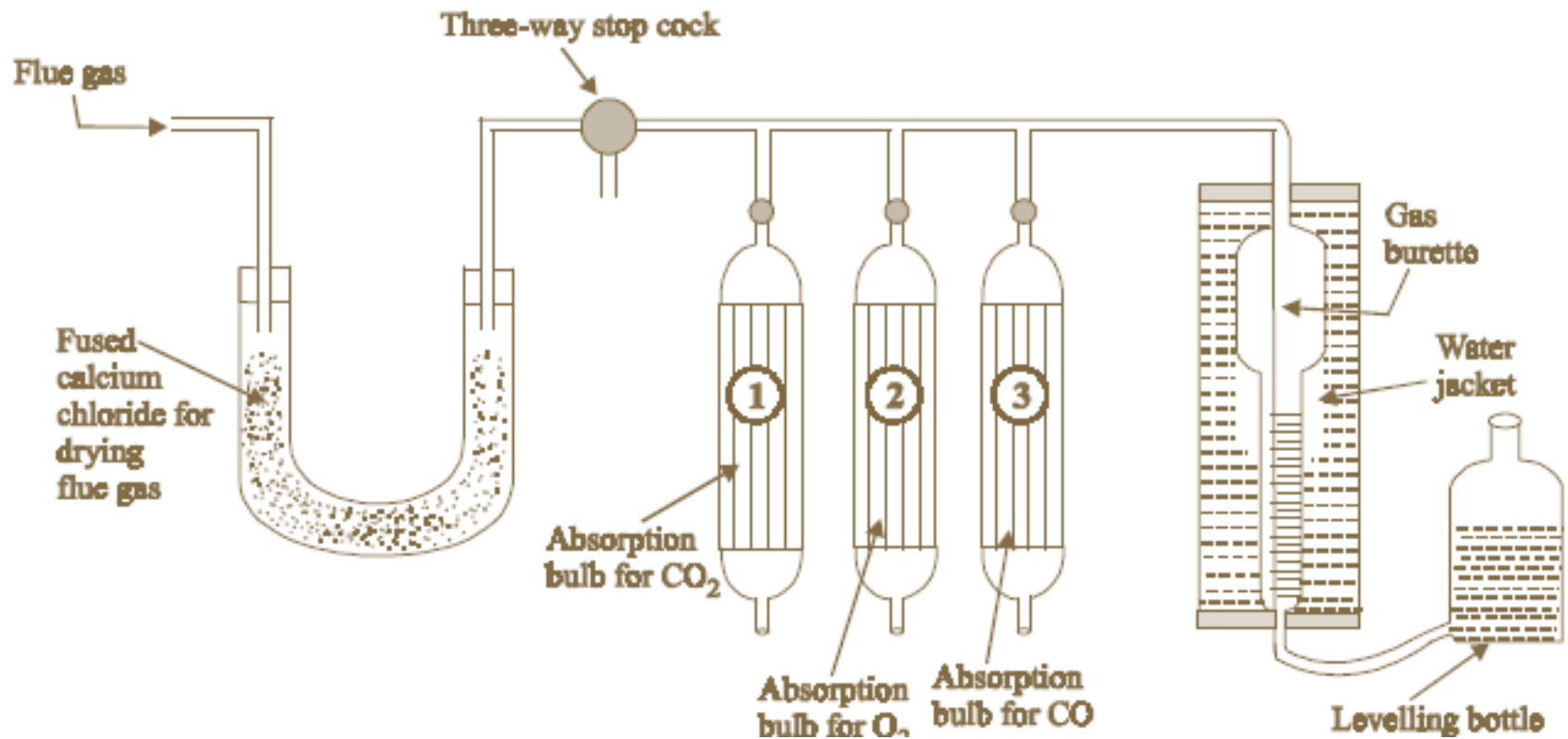
- The 3-way stop-cock is opened to the atmosphere and the reservoir is raised, till the burette is completely filled with water
- The air is excluded from the burette
- The 3-way stop-cock is now connected to the flue gas supply
- The flue gas is sucked into the burette and the volume of flue gas is adjusted to 100 cc by raising and lowering the reservoir
- Then the 3-way stop cock is closed.



ORSAT'S METHOD

(a) Absorption of CO_2

- The stopper of the absorption bulb-1, containing KOH solution, is opened and all the gas is passed into the bulb-1 by raising the level of water in the burette
- The gas enters into the bulb-1, where CO_2 present in the flue gas is absorbed by KOH.
- The gas is again sent to the burette
- This process is repeated several times to ensure complete absorption of CO_2
- The decrease in volume of the flue gas in the burette indicates the volume of CO_2 in 100 cc of the flue gas.





(b) Absorption of O₂

- Stop-cock of bulb-1 is closed and stop cock of bulb-2 is opened
- The gas is again sent into the absorption bulb-2, where O₂ present in the flue gas is absorbed by alkaline pyrogallol
- The decrease in volume of the flue gas in the burette indicates the volume of O₂.

(c) Absorption of CO

- Now stop-cock of bulb-2 is closed and stop-cock of bulb-3 is opened



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- The remaining gas is sent into the absorption bulb-3, where CO present in the flue gas is absorbed by ammoniacal cuprous chloride
 - The decrease in volume of the flue gas in the burette indicates the volume of CO
 - The remaining gas in the burette after the absorption of CO₂, O₂ & CO is taken as nitrogen.



Significance or uses of flue gas analysis

1. Flue gas analysis gives an idea about the complete or incomplete combustion process.
2. If the flue gases contain considerable amount of CO, it indicates that incomplete combustion is occurring and it also indicates that the short supply of O₂.
3. If the flue gases contain considerable amount of O₂, it indicates that complete combustion is occurring and also it indicates that the excess of O₂ is supplied



Precautions

1. Care must be taken in such a way that, the reagents in the absorption bulb 1, 2 and 3 should be brought to the etched marked level one by one by raising and lowering reservoir bottle.
2. All the air from the reservoir bottle is expelled to atmosphere by lifting the reservoir bottle.
3. It is essential that CO_2 , O_2 and CO are absorbed in that order only.
4. As the CO content in flue gas is very small, it should be measured quite carefully.

THANK YOU