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PHYSICAL SCIENCE

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ESTIMATION OF FORMIC ACID FROM DIFFERENT TYPES OF ANTS

Physical Science

Junior Level

OMEIAT VIRTUAL SCIENCE FAIR
PHYSICAL SCIENCE RESEARCH PAPER
JUNIOR LEVEL PHYSICAL SCIENCE

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Grade : Grade IX

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Project Title : ESTIMATION OF FORMIC ACID FROM DIFFERENT TYPES OF ANTS

ABSTRACT

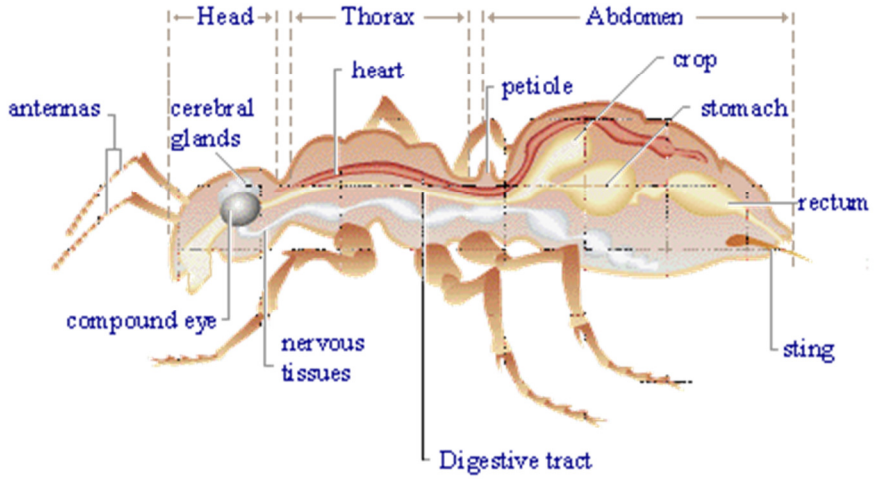
The present study was conducted to investigate and compare the amount of formic acid present in red and black ants. I used volumetric analysis method to calculate the amount of formic acid present in both ants. From my investigation I found that the amount of Formic acid present in black ant is 0.034g and the amount of Formic acid present in Red ant is 0.0276g and concluded that the black ants have more formic acid than the red ants.

BACKGROUND INFORMATION

For over 600 years naturalists knew that ant hills gave off an acidic vapor. In 1671, the English naturalist John Ray describe the isolation of the active ingredient. To do this he collected and distilled a large number of dead ants and the acid he discovered later became known as formic acid from the Latin word for ant, formica. Its proper IUPAC name is now methanoic acid.

Formic acid is also present in a natural state in stinging nettles and is reponsible for the burning feeling on contact with them. It is also found in the

stings and bites of many insects, including bees and ants, which use it as a chemical defence mechanism. When the ant contracts its poison gland, the formic acid stored in this gland passes in the sting and is propelled out in jets (up to a distance of one metre in some species!) toward the attackers of the ant. Since formic acid has a pH of ~2-3, the attackers usually flee, or are killed.

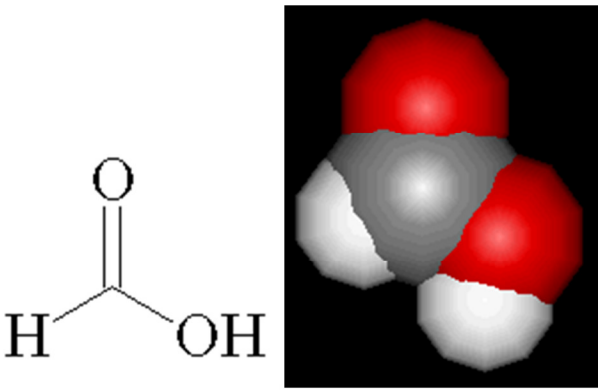


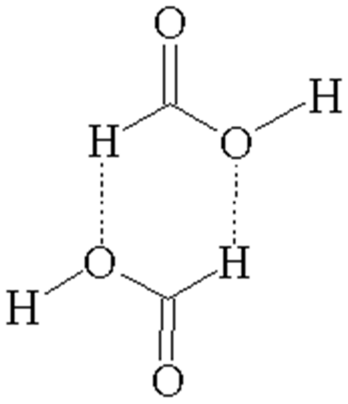
The first synthesis of formic acid was by the French chemist Joseph Gay-Lussac, who used hydrocyanic acid as a starting material. In 1855, another

French chemist, Marcellin Berthelot, developed a synthesis from carbon monoxide that is similar to the one used today.

Chemical structure and properties

The chemical formula of formic acid is HCOOH, and it is a planar molecule.





Formic acid is a colourless, fuming liquid that is miscible with water. In the vapor phase, it consists of hydrogen bonded dimers (see picture, right) rather than individual molecules. In the gas phase, significant deviations from the ideal gas law arise as a result of this hydrogen bonding. In its liquid and solid state, formic acid can be thought of as an effectively infinite network of hydrogen bonded molecules.

Being the first in the carboxylic acid series, formic acid shares most of the same chemical properties, and so it will react with alkalis to form water soluble formate salts. But formic acid is unique among the carboxylic acids in that it reacts with alkenes to form formate esters. In the presence of sulfuric and hydrofluoric acids, a variant of the Gatterman-Koch reaction takes place instead, and formic acid adds to the alkene to produce a larger carboxylic acid.

Production

Formic acid is produced as a by-product in the manufacture of acetic acid. However, the industrial demand for formic acid is higher than can be made from this route, so dedicated production routes have been developed. One method combines methanol and carbon monoxide in the presence of a strong base, such as sodium methoxide, to produce methyl formate, according to the chemical equation:

$$CH_3OH + CO \rightarrow HCOOCH_3$$

Hydrolysis of this produces formic acid:

$$HCOOCH_3 + H_2O \rightarrow HCOOH + CH_3OH$$

Applications

The main use of formic acid is for livestock feed in Europe, as a preservative and antibacterial agent. It can be sprayed on fresh hay or other silage to stop or delay certain decay processes. It therefore allows the feed to survive longer, and so it is widely used to preserve winter feed for cattle. In the poultry industry, it is sometimes added to feed to kill salmonella bacteria. Some beekeepers also use formic acid as a fumigant to kill a mite which attacks the bees. Formic acid is used in textile dyeing and finishing, leather tanning, nickel plating baths, electroplating, coagulating rubber latex, regenerating old rubber, and dehairing and plumping hides, and in some commercial paint strippers. It is used to make metal salts, including nickel, cadmium, and potassium formates. It is used as a solvent for perfumes, and in the manufacturing of lacquers, glass, vinyl resin plasticizers, and formate esters for flavor and fragrance. It is used in the synthesis of the artificial sweetener, aspartame.

STATEMENT OF THE PROBLEM

One day while I was playing an ant bit me on my index finger. Immediately that part swollen. But I did not get that much swollen when a red ant had already bitten me. I already knew that the main reason for this swelling is the presence of Formic acid in both red ant and black ant. Since formic acid is found in black ant and Red ant, I would like to know and compare how many grams of Formic acid are present in both ants.

HYPOTHESIS

The Black ants have more Formic acid then Red ants.

DESIGN OF STUDY

- ***Independent Variable:*** Black ant and Red ant.
- ***Dependent Variable:*** Amount of Formic acid
- ***Controlled Variable***: NaOH (Sodium hydroxide), HCl (Hydrochloric acid) and Phenolphthalein Indicator

Material Required:

- Burette
- Pipette
- Conical Flask
- Round bottom Flask
- Glass Rod

- Beaker
- Digital Balance
- Collecting sample container
- Sugar or breadcrumbs
- Whatman filter paper
- Funnel
- Black Ants
- Red Ants
- NaOH (Sodium Hydroxide)
- HCl (Hydrochloric acid)
- Phenolphthalein Indicator

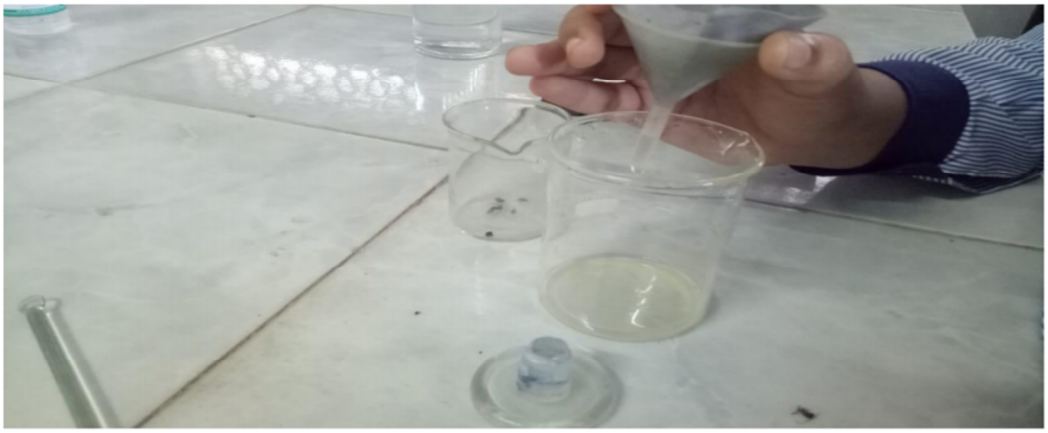
Procedure:

Methods of sample collection:

- Take some amount of sugar or breadcrumbs in a container.
- Place the container next to the ant nest.
- After some time, we can collect ants which will arrive to the container to the collect the food.

Extraction of Formic acid from the ant:

- Take 20ml of water in a beaker.
- Put the ant into the water.
- Crush it with appropriate equipment and filter off.
- Then take the filter end and makeup as needed.



Estimation of Formic Acid

TITRATION 1

- Take standard Hydrochloric acid solution in burette up to zero mark and note the initial reading for lower meniscus.
- 20ml of pipetted out unknown NaOH solution and transfer into the clean conical flask.
- 2 to 3 drops of phenolphthalein indicator is added in to the same conical flask.
- The solution is titrated against the standard HCl solution.
- The end point is the disappearance of pink colour.
- The titration is repeated to get concordant value.

TITRATION II

- Take Unknown Formic acid in burette up to zero mark and note the initial reading for Lower meniscus.
- 20ml of NaOH pipetted out and transfer into the clean conical flask.
- A one drop of phenolphthalein indicator is added into the clean same conical flask.
- The solution is titrated against the link Sodium hydroxide solution.
- The end point is the disappearance of pink colour.

Data and Calculation

TABLE-ITITRATION-I STD HClvsNaOH (link)Indicator:

S.NO	Volume Of Standard NaOH (ml)	Burettr eading Initial (ml)	Burettr eadingF inal(ml)	Volume of Std. HCl (ml)	Conc ordan t value
1	20	0	23.8	23.8	
2	20	0	23.7	23.7	23.8
3	20	0	23.8	23.8	

CALCULATION

Volume of NaOH(v_1) = 20ml

Normality of NaOH(N_1) = ?

Volume of HCl(V_2) = 23.8 ml

Normality of HCl (N_2) = 0.1N

$$V_1N_1 = V_2N_2$$

$$N_1 = \frac{V_2 N_2}{V_1}$$

$$= \frac{23.8 \times 0.1}{20}$$

$$= 0.119N$$

TITRATION II –Red Ant

Link NaOHVs Unknown formic Acid in Red Ant

Indicator:Phenolphthalein

S. NO	Volume Of Link NaOH (ml)	Burette Readin gIntial (ml)	Burette Readin gFinal (ml)	Volume of Unknow n formic Acids (ml)	Concor dent Value (ml)	Type of ant
1	20	0	39.5	39.5		Red ant
2	20	0	39.4	39.4	39.5	
3	20	0	39.5	39.5		

Calculation

Volume of unknown formic acid solution V1 = 39.5

Normality of unknown formic acid N1 = ?

Volume of NaOH Solution V2 = 20 ml

Normality of NaOH solution N2 = 0.119N

According to Normality equation

V1N1 = V2N2

$$N1 = \frac{V2N2}{V1}$$

$$= \frac{20\ X\ 0.119}{39.5}$$

Normality of formic acid solution = 0.0602N

Weight Calculation

The amount of formic acid dissolved in 1 liter of the solution= Normality x equivalent weight

The amount of formic acid dissolved in 500 ml

$$= \frac{\text{Normality x equivalent weight } 500}{1000}$$

$$= \frac{0.0602X46X500}{1000}$$

$$= 1.384g$$

In 50 red ant produce =...1.384..... g of formic acids

One red ant produce $= \frac{1.384}{50} = 0.0276g$

TITRATION II –Black Ant
Link NaOHVs Unknown formic Acid in Black Ant
Indicator: Phenolphthalein

S. NO	Volume Of Link NaOH	Burette Reading		Volume of (ml) Unknown Formic acid	Con cordent Value (ml)	Type of ant
		Initial (ml)	Final (ml)			
1	20	0	32.0	32.0		Black ant
2	20	0	32.0	32.0	32.0	
3	20	0	32.1	32.1		

Calculation for black ant

Volume of unknown formic acid solution V1 = 32.0

Normality of unknown formic acid N1 = ?

Volume of NaOH Solution V2 = 20 ml

Normality of NaOH solution N2 = 0.119N

According to Normality equation

$$V1N1 = V2N2$$

$$N1 = \frac{V2N2}{V1}$$

$$= \frac{20 \; X \; 0.119}{32}$$

Normality of formic acid solution = 0.074N

Weight Calculation

The amount of formic acid dissolved in 1 liter of the solution

=Normality x equivalent weight

The amount of formic acid dissolved in 200ml =

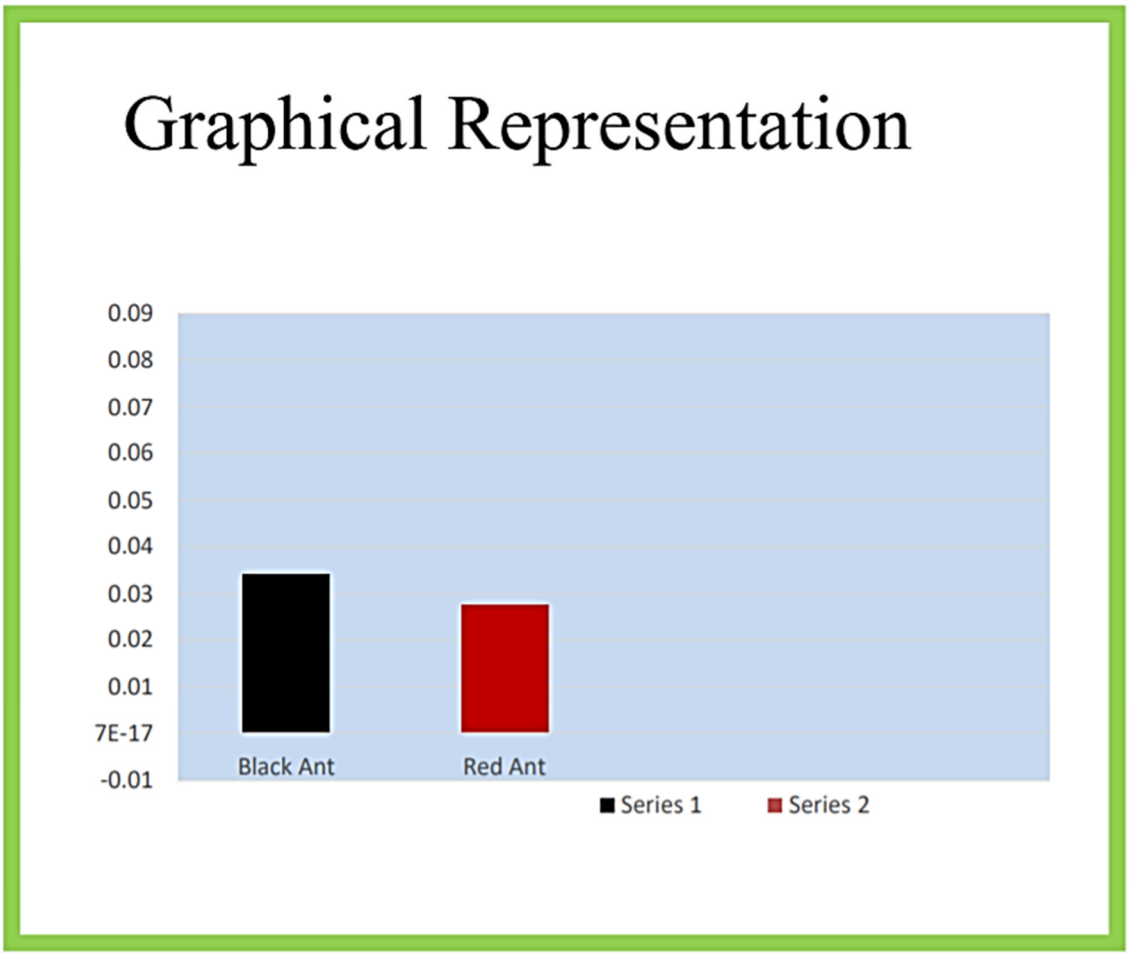
$$\frac{\text{Normality x equivalent weight } 200}{1000}$$

$$= \frac{0.074 \; x \; 46 \; x 200}{1000}$$

= 0.6808g

In 20 Black ant produce =...0.6808..... g of formic acids

One Black ant produce = $\frac{0.6808}{20}$ = 0.034g



RESULT AND CONCLUSION

Result:

1.The normality of NaOH = 0.119N

2.Normality of formic acid solution of red ant = 0.0602N

3.Normality of formic acid solution of black ant= 0.074N

4.The amount of Formic acid present in black ant is = 0.034g

5.The amount of Formic acid present in Red ant is = 0.0276g

Conclusion:

The Black ants have more Formic acid than Red ants. My hypothesis is proved true.

ACKNOWLEDGEMENT

I would like to express my special thanks of gratitude to our school management. I would also like to extend my gratitude to Principal madam and my dear teachers for providing as with all facility that was required. I done this project to enrich my knowledge. Thanks again to all who helped me.

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REPLICA TO LPG

Physical Science

Junior Level

REPLICA TO LPG

Student Name : MOHAMMED MAAZ.M

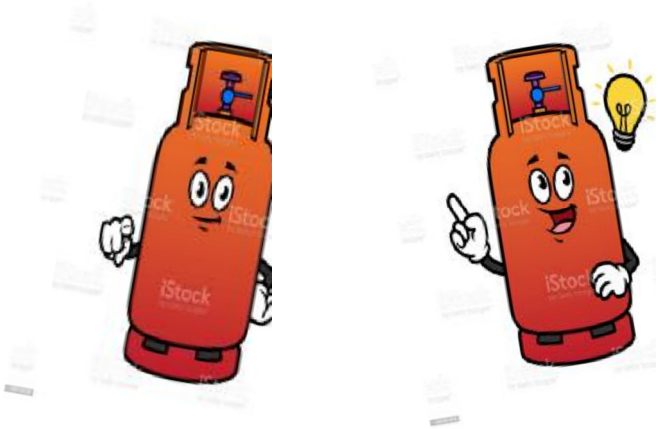
Grade : GRADE X

School Name : KH MATRIC BOYS HR.SEC SCHOOL THENNANDIYALAM

Project Title : REPLICA TO LPG
REACTION OF GASOLINE WITH WATER

ABSTRACT

For my project **"REPLICA TO LPG- Reaction of Gasoline with Water"** I selected petrol, kerosene and diesel. I planned to react those with different kinds of water such as normal fresh water, sea water and distilled water to extract fuel producing gas. At the end I got fuel from my experiment which leads to the replica to LPG which may be also used as low cost stove. My goal is to recommend a low cost stove which the poor people can easily afford. Through my research work, I found that petrol with salt water gives fuel for more number of days than other gasoline.



BACKGROUND INFORMATION

ABOUT PETROL

When people consider petroleum, they first think of energy. Petroleum and other fossil fuels now provide more than 86% of the energy consumed by mankind. In addition, fossil resources, especially petroleum and natural gas, serve as the organic source of tens of thousands of consumer products, which enrich our daily lives. To understand petroleum and the petroleum industry, one must be familiar with the technology used to find and recover crude oil and natural gas and transform them into useful products. These technologies can also be applied to gases and liquids from coal, shale, and renewable biomass. Research and development aimed at improving or modifying existing technologies and developing new ones usually require physical testing and chemical characterization. When people consider petroleum, they first think of energy. Petroleum and other fossil fuels now provide more than 86% of the energy consumed by mankind. In addition, fossil resources, especially petroleum and natural gas, serve as the organic source of tens of thousands of consumer products, which enrich our daily lives.

ABOUT DIESEL

Diesel fuel, also called diesel oil, combustible liquid used as fuel for diesel engines, ordinarily obtained from fractions of crude oil that are less volatile than the fractions used in gasoline. In diesel engines the fuel is ignited not by a spark, as in gasoline engines, but by the heat of air compressed in the cylinder, with the fuel injected in a spray into the hot compressed air. Diesel fuel releases more energy on combustion than equal volumes of gasoline, so diesel engines generally produce better fuel economy than gasoline engines. In addition, the production of diesel fuel requires fewer refining steps than gasoline, so retail prices of diesel fuel traditionally have been lower than those of gasoline (depending on the location, season, and taxes and regulations). On the other hand, diesel fuel, at least as traditionally formulated, produces greater quantities of certain air pollutants such as sulfur and solid carbon particulates, and the extra refining steps and emission-control mechanisms put into place to reduce those

emissions can act to reduce the price advantages of diesel over gasoline. In addition, diesel fuel emits more carbon dioxide per unit than gasoline, offsetting some of its efficiency benefits with its greenhouse gas emissions.

ABOUT KEROSENE

Kerosene, also known as paraffin, is a combustible hydrocarbon liquid which is derived from petroleum. It is widely used as a fuel in aviation as well as households. Its name derives from Greek: κηρός (keros) meaning "wax" and was registered as a trademark by Canadian geologist and inventor Abraham Gesner in 1854 before evolving into a genericized trademark. It is sometimes spelled kerosine in scientific and industrial usage. The term kerosene is common in much of Argentina, Australia, Canada, India, New Zealand, Nigeria, and the United States, while the term paraffin (or a closely related variant) is used in Chile, eastern Africa, South Africa, Norway, and in the United Kingdom. The term lamp oil, or the equivalent in the local languages, is common in the majority of Asia. Liquid paraffin (called mineral oil in the US) is a more viscous and highly refined product which is used as a laxative. Paraffin wax is a waxy solid extracted from petroleum. Kerosene is widely used to power jet engines of aircraft (jet fuel) and some rocket engines in a highly refined form called RP-1. It is also commonly used as a cooking and lighting fuel, and for fire toys such as poi. In parts of Asia, kerosene is sometimes used as fuel for small outboard motors or even motorcycles. World total kerosene consumption for all purposes is equivalent to about 1.2 million barrels (50 million U.S. gallons; 42 million imperial gallons; 190 million liters) per day.

ABOUT SEA WATER

Sea water, water that makes up the oceans and seas, covering more than 70 percent of Earth's surface. Seawater is a complex mixture of 96.5 percent water, 2.5 percent salts, and smaller amounts of other substances, including dissolved inorganic and organic materials, particulates, and a few atmospheric gases.

ABOUT DISTILLED WATER

Distilled water is water that has been boiled into vapor and condensed back into liquid in a separate container. Impurities in the original water that do not boil below or near the boiling point of water remain in the original container. Therefore, distilled water is one type of purified water.

STATEMENT OF THE PROBLEM

The price of Liquefied Petroleum Gas (LPG) domestic gas cylinder (14.2 kg) hiked by 50 per cylinder; to be at 769 per cylinder in Delhi from. news agency ANI reported. This is the second price hike in the month of February. The oil marketing companies had increased the price of non-subsidized LPG cylinders by 25 in metro cities on February.

As per 15 March 21, rate of LPG is given below.

The retail price of a 14.2 LPG cylinder in Chennai stood at around Rs.900/-

Today's LPG Price in Chennai.

Today's Price	Rs.835 for 14.2 kg cylinder
Today's LPG Price with Subsidy	Rs.835 for 14.2 kg cylinder
Highest in FY 2020	Rs.835.00 per cylinder in March 2021
Lowest in FY 2020	Rs.569.50 per cylinder in May 2020

Now we can't survive in this hard pandemic situation. So, I planned to design a replica for LPG with low cost.

HYPOTHESIS

Petrol with saltwater gives fuel for more number of days than other gasoline.

DESIGN OF STUDY

- ***Independent Variable:*** Different kinds of gasoline (Petrol, Diesel, Kerosene)
- ***Dependent Variable:*** Amount of Fuel
- ***Controlled Variable***: Quantity of water & gasoline, Experimental Conditions

Material Required:

- Bottles,
- Air pump motor,
- Battery,
- Silicon pipe,
- Petrol,
- Kerosene,
- Diesel,
- Water,
- Sea water
- Distilled water
- Lighter
- Metal box
- Stove

Procedure:

- Take two half filled (1-petrol and 2-water) bottles and insert silicon tube connected with air pump motor which leads to the stove.
- Switch on the motor and then pressure is applied to the bottle 1 to bottle 2 which evaluates the fuel at the other end. This is due to the evaluation of H_2 gas.
- The fuel can be controlled using controller attached in the tube.
- It gives blue as well red flame.

- Measure the time for which the flame burns and the quantity of gasoline consumed.
- Repeat the above steps for diesel and kerosene.

Safety Measures:

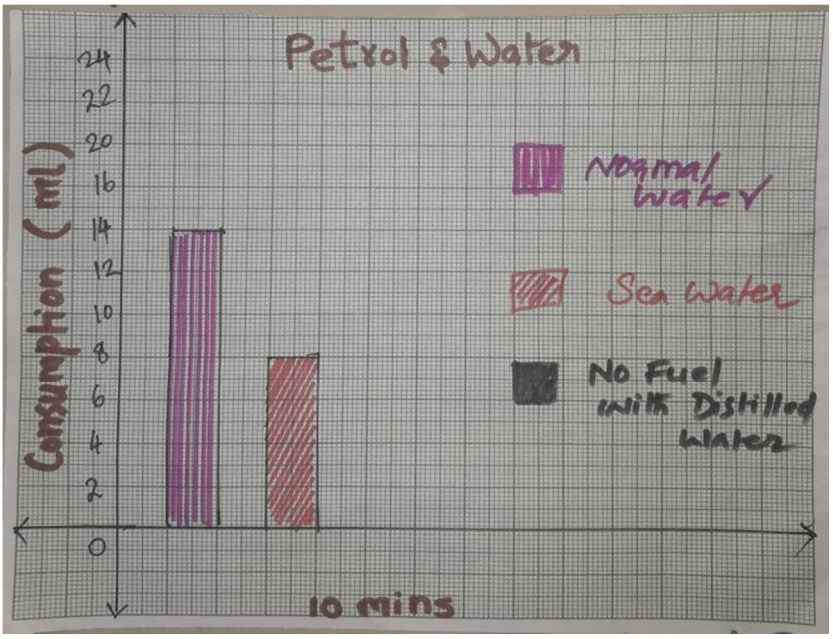
- Safety measures are very important.
- The bottles filled with petrol, diesel should be kept far away from burner.
- Sometimes due to high voltage, pump motor gets excess amount of charge and absorption will take place. i.e., the gasoline will get back to water bottle and immiscible but fuel won't produce from this kind of process.
- The connecting silica tube should be kept straight for gas to pass comfortably.

DATA ANALYSIS

REACTION OF PETROL WITH DIFFERENT WATER

S.NO	REACTION	TIME (BURNING)	QUANTITY (CONSUMPTION OF PETROL)
1	PETROL and WATER	10 MINS	14 ml
2	PETROL and SEA WATER	10 MINS	8 ml
3	PETROL and DISTILLED WATER	0 MINS	NO FUEL

If time increases the consumption also increases
E.g.: For 20 mins it takes 15-16 ml for Petrol with salt water

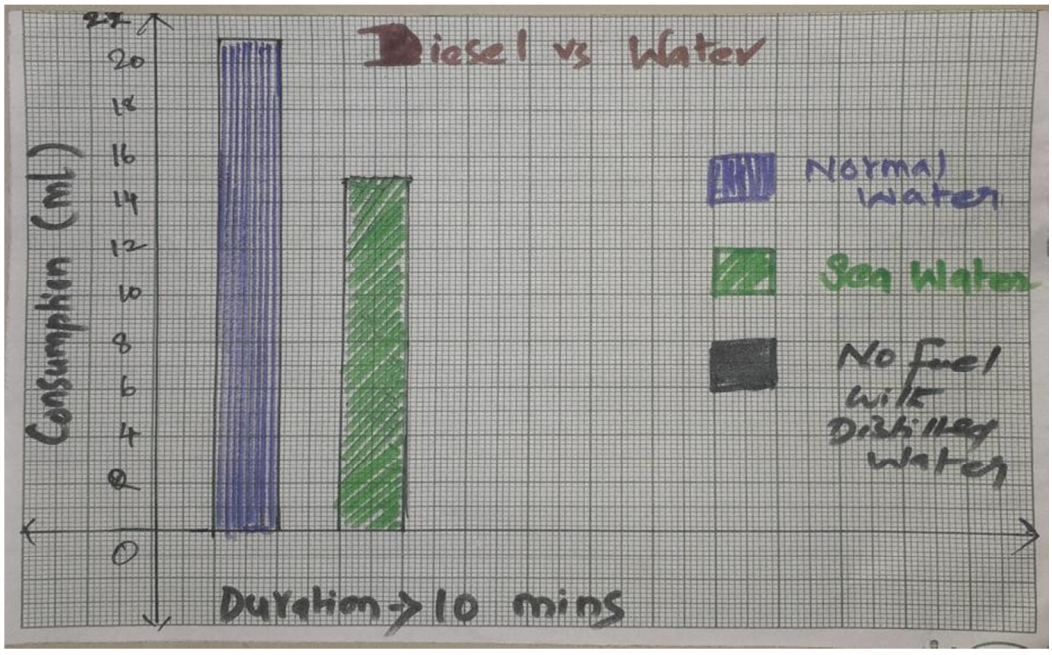


REACTION OF DIESEL WITH DIFFERENT WATER

S.NO	REACTION	TIME (BURNING)	QUANTITY (CONSUMPTION OF DIESEL)
1	DIESEL and WATER	10 MINS	21 ml
2	DIESEL and SEA WATER	10 MINS	15 ml
3	DIESEL and DISTILLED. WATER	0 MINS	NO FUEL

If time increases the consumption also increases

E.g.: For 20 mins it takes 30 ml for diesel with water

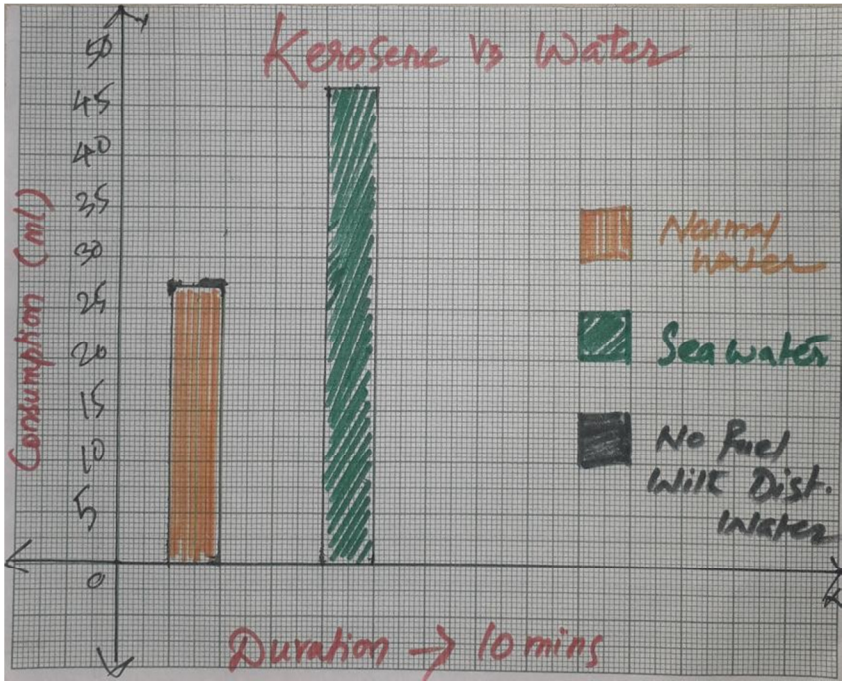


REACTION OF KEROSENE WITH DIFFERENT WATER

S.NO	REACTION	TIME (BURNING)	QUANTITY (CONSUPTION OF KEROSENE)
1	KEROSENE VS WATER	10 MINS	27 ml
2	KEROSENE VS SEA WATER	10 MINS	42 ml
3	KEROSENE VS DISTILLED WATER	0 MINS	NO FUEL (0 ml)

If time increases the consumption also increases

Eg : For 20 Mins it takes around 60 ml for kerosene with water.



RESULT AND CONCLUSION

Result

- *From above experiments, the reaction of gasoline and water works out well to produce fuel which is useful for cooking process.*
- ***Among them reaction of petrol with salt water consumes less amount comparing to others.***

Conclusion:

- *From above experimentations I have concluded that the gasoline reacts with water to evaluate hydrogen gas which is very useful for burning process. Then I have compared all the three petrol, diesel and kerosene with water to get fuel.it is really worked out and my thought process of replacing LPG came true.*
- *Also from data analysis, consumption of petrol with sea water is better.*

APPLICATIONS

- My low cost stove will be very useful and helpful for poor people who can't afford LPG.
- It is very useful for lab burners. In spite of using gas cylinder we can use our stove. We can control the flame using controller.
- This stove is helpful for baking process.
- It can be used in hotels in spite of commercial cylinders.
- Kitchen stoves rely on the application of direct heat for the cooking process and may also contain an oven, used for baking.

FUTURE ENHANCEMENT

If it would work out in two-wheeler engine, it may be great revolution for petrol vehicles.

ACKNOWLEDGEMENT

I am very much thankful to **Almighty ALLAH** for this innovative research working opportunity.

I am over helmed in all humbleness and gratefulness to acknowledge my depth to all those who have helped me to put these ideas, well above the level of simplicity and into something concrete.

I would like to express my special thanks of gratitude to my Science Master **Mr.D.HIFZUR RAHMAN** ***Msc.,MPhil.,B.Ed.,*** as well as our Principal ***Mr.I.MOHAMMED AEJAZ Msc.,MPhil.,B.Ed.,*** who gave me the golden opportunity and guided me to do this wonderful project on the topic **" REPLICA TO LPG @ LOW COST STOVE – Reaction of Gasoline with Water",** which also helped me in doing a lot of Research and I came to know about so many new things. I am really thankful to them.

Any attempt at any level can't be satisfactorily completed without the support and guidance of my **parents and friends**.

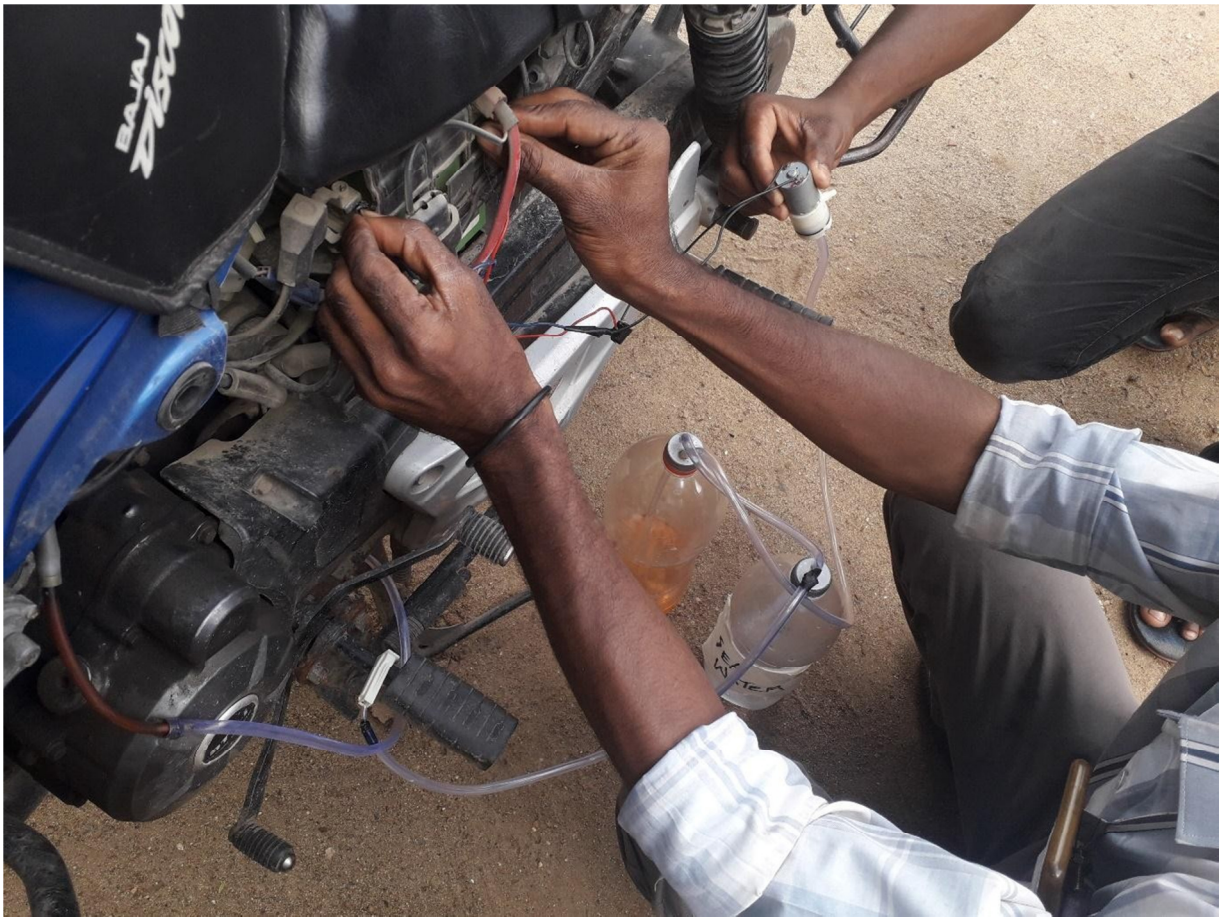
I would like to thank my parents who helped me a lot in gathering different information, collecting data and guiding me from time to time in making this project, despite of their busy schedules, they gave me different ideas in making this project unique.

PHOTOGRAPHS

These bottles can be fixed into iron container for safety measures.


AQUA FIST
Salt Water


OMEIAT
National Science Fair-21
SPEAK ENGLISH ALL THE TIME, EVERYWHERE
AQUA FIST
Salt Water



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