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# SCOPE OF CHEMICAL TECHNOLOGY IN SPACE RESEARCH

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**Abstract**

*Space research is scientific studies carried out using scientific equipment in Outer space. It includes the use of space technology for a broad spectrum of research disciplines, including Earth science, materials science, biology, medicine, and Physics. Space research includes earth observations, atmospheric science, planetology, space physics, astronomy, material sciences, life sciences, physics, etc. In this project we are presenting the scope for chemical engineering in space research and technology and their role in the research and space technology and we have discussed some work jobs carried out by chemical engineers such as managements, astronauts, test directors, testing batteries, etc*

***Index Terms:*** *space technology, space research, rocket sciences.*

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## 1. INTRODUCTION

Chemical engineering has a number of applications in our day to day lives. Chemical engineering also has applications in production of electronics, clothing, paper and photographic equipment etc. The scope for individuals in the field of chemical engineering is bound to grow in time. This is mainly because of industrial growth as well as the related scarcity of the resources those are required. In future years, chemical engineers will be needed to develop synthetic replacement for those resources as well as materials that are low in supply. In overall, it can be said that chemical engineers will be able to make very crucial contributions to the improvement in addition to the maintenance of the quality of our lives. Chemical Engineering techniques are used for the production of usable, high quality products such as fibres, fabrics, paints, medical drugs, biomaterials, gasoline, lubricants etc used in various industries such as textile, food, plastics, automotive, aerospace, petroleum, oil and gas, biomedical, biotechnology and pharmaceuticals, thereby increasing the scope of Chemical Engineering.

### 1.1. ROLE OF CHEMICAL TECHNOLOGY IN LAUNCHING AND TESTING OF SATELLITES

In launching of a satellite, after the satellite is assembled it is then sent to check out process for testing the work in condition of the satellites. In space the atmosphere varies in terms of temperature and vaccum sometimes it is very low and sometimes it is very high therefore in thermo vaccum chamber the assembled satellite is tested at different ranges of varying temperature.

This thermo-vaccum chambers are usually designed and manufactured by chemical engineers .In this thermo vaccum chambers the temperature is cooled down by liquid nitrogen in pipes externally and at the time of launching of the satellite a large amount of power generation is required and the chemical engineers are involved in this process of power and fuel generation.

### 1.2 MATERIALS USED FOR MANUFACTURING OF AIRCRAFT

The material should have properties like resisting gravitational force, the material used for construction of air craft must have a small weight, specific strength, heat resistance, fatigue load resistant, crack resistant and corrosion resistance.

The chemical engineer works on selecting the material of construction on the basis of these properties and lot of new research is going on these properties.

Now aluminium, steel titanium and composite material are preferred in these construction of air craft structures aluminium is used due to its low density (2.7 g/ ), high strength, good thermal and electric conductivity, technological effectiveness and high corrosion resistance but because aluminium loses its strength at higher temperature, it is not used in the skin surface of an aircraft. Steel is an alloy of iron and carbon which can be three times stronger and heavier than aluminium. It is usually used in landing air due to strength and hardness as well as in the skin surface of air craft due to its high heat resistance.

## 2. ROCKET SCIENCE:

There are two main categories of rocket engines; liquid rockets and solid rockets. In a liquid rocket, the propellants, the fuel and the oxidizer, are stored separately as liquids and are pumped into the combustion chamber of the nozzle where burning occurs. In a solid rocket, the propellants are mixed together and packed into a solid cylinder. Under normal temperature conditions, the propellants do not burn; but they will burn when exposed to a source of heat provided by an ignitor. Once the burning starts, it proceeds until all the propellant is exhausted. With a liquid rocket, you can stop the thrust by turning off the flow of propellants; but with a solid rocket, you have to destroy the casing to stop the engine. Liquid rockets tend to be heavier and more complex because of the pumps and storage tanks. The propellants are loaded into the rocket just before launch. A solid rocket is much easier to handle and can sit for years before firing.


**Fig-1: Rocket schematic**

a) Combustion chamber
b) Converging and diverging nozzles
c) Pumps
d) Throat
e) Fuel tank
f) Oxidizer tank

**2.2. CHEMICAL ROCKETS**

Chemical rockets work by heating a gas through chemical reaction. This gas is then expanded through a nozzle. Chemical rockets can be classified based on the form of the fuel they use.

Types of fuels used in rocket

There are different types of fuels used in aviation industry and the fuel to be used will be based on type of engine installed in the aircraft. The fuel used in commercial aircraft’s and in fighter aircraft’s is kerosene based, where complete purified kerosene is used and in addition to that some additives like anti-freeze, antioxidants, hydrocarbons, metal deactivators because these additives enhance the material of the gas turbines from corrosion, freezing at higher altitudes and from other damages. Generally in aviation industry there are 3 types of fuel in use. Below is the Aviation fuel table which gives you grade, colour and usage of different aviation fuels.

1. Kerosene based fuel

a) JET A

It is a similar kerosene type of fuel produced to an ASTM specifications and normally only available in the U. S. A. There is a very little physical difference between Jet A (JP-5) fuel and commercial Kerosene. Jet A was developed as a heavy kerosene having higher flash point a higher freezing point than normal kerosene. They have e low vapour pressure and flash points are between 110 deg F and 110 deg F.

b) JET A1

JET A1 is a kerosene grade of fuel suitable for most turbine engine aircraft. It has a flash point minimum Jet B is called wide cut fuel because it is a blend of gasoline & kerosene fractions. Jet B has freezing point, around -60 deg C & its vapour pressure is that higher than that of kerosene & lower than that of gasoline. This fuel is mostly used in cold weather regions.

2. Military based fuels ( jp-1 to jp-8)

c) JP-1

It was a pure kerosene fuel with high flash point and a freezing point of −60 °C (−76 °F). The low freezing point requirement limited availability of the fuel and it was soon superseded by other "wide cut" jet fuels which were kerosene-naphtha or kerosene-gasoline blends.

d) JP-2 AND JP-3

JP-2 was intended to be easier to produce than JP-1 since it had a higher freezing point, but was never widely used. JP-3 was even more volatile than JP-2 and intended to improve production, but its volatility led to high evaporation loss in service.

e) JP-4

It was a flammable transparent liquid with clear or straw colour, and a kerosene-like smell. It evaporated easily and floated on water. Although it had a low flash point (0 °F (−18 °C)), a lit match dropped into JP-4 would not ignite the mixture. JP-4 froze at −76 °F (−60 °C), and its maximum burning temperature was 6,670 °F (3,688 °C).

f) JP-5

It is a yellow kerosene-based jet fuel P-5 is a complex mixture of hydrocarbons, containing alkanes, naphthenes and aromatic hydrocarbons and has a high flash point (min. 60 °C or 140 °F). Its freezing point is −46 °C (−51 °F). It does not contain antistatic agents.

g) JP-6

This is a type of jet fuel developed for the General Electric YJ 93 jet engine of the XB-70 Valkyrie supersonic aircraft. JP-6 was ideal for the high altitude bomber, being similar to JP-5 but with a lower freezing point and improved thermal oxidative stability. Freezing point is -65 deg F.

h) JP-7

This was developed for the twin Pratt & Whitney J58 Turbojet/ ramjet engines of the SR-71 Blackbird and has a high Flash Point to better cope with the heat and stresses of high speed supersonic flight.

i) JP-8

JP-8 was specified and used widely by the US military. It is similar to commercial aviation's Jet A1, but with the addition of corrosion inhibitor and anti-icing additives. Freezing point, maximum: -47 deg C. Flash Point 38 deg C.

Two types of chemical rockets-

1. Solid rocket
2. Liquid rocket

SOLID ROCKET- Solid rocket engines are used on air-to-air and air-to-ground missiles, on model rockets and as boosters for satellite launchers. In a solid rocket, the fuel and oxidizer are mixed together into a solid propellant which is packed into a solid cylinder. A hole through the cylinder serves as a combustion chamber.

When the mixture is ignited, combustion takes place on the surface of the propellant. A flame front is generated which burns into the mixture. The combustion produces great amounts of exhaust gas at high temperature and pressure. The amount of exhaust gas that is produced depends on the area of the flame front and engine designers use a variety of hole shapes to the change in thrust for a particular engine. The hot exhaust gas is passed through a nozzle which accelerates the flow. Thrust is then produced according to Newton's third law of motion.

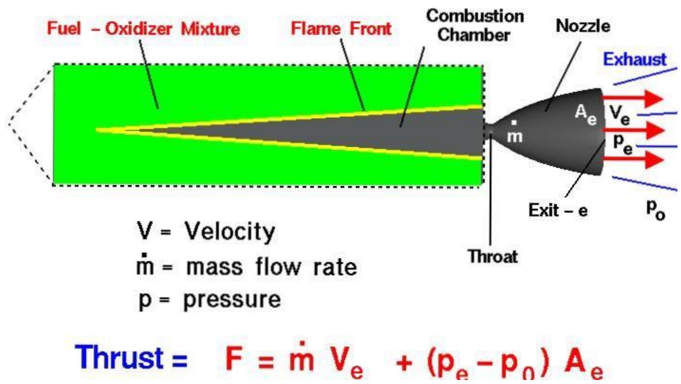


**Fig-2: solid propellant**

LIQUID ROCKET- Liquid rocket engines are used on the space shuttle to place humans in orbit, on many un-manned missiles to place satellites in orbit, and on several high speed research aircraft following World War II. In a liquid rocket, stored fuel and stored oxidizer are pumped into a combustion chamber where they are mixed and burned. The combustion produces great amounts of exhaust gas at high temperature and pressure. The hot exhaust is passed through a nozzle which accelerates the flow. **Thrust** is produced according to Newton's third law of motion.

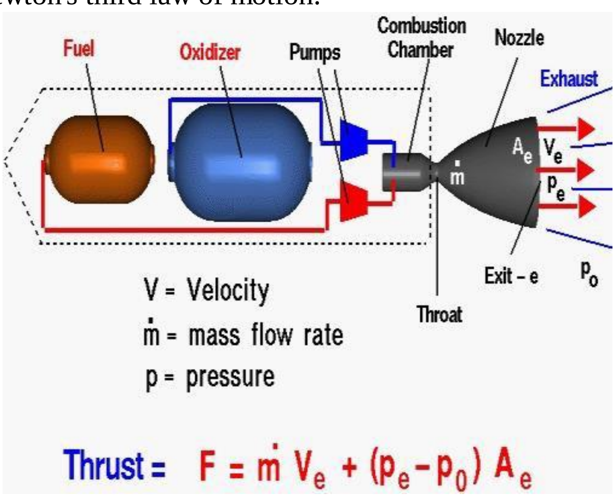


**Fig-3: Liquid propellant**

## 3. CONCLUSION

Hence we conclude that there is a vast scope for chemical engineering in space research and technology and there is an essential need of chemical engineer in space research and technology and we have discussed about rocket science, astronauts, types of fuel used in rockets and schematic working of rockets.

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**REFERENCES**

[1]. www.ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20080031614.pdf

[2]. http://www.isro.gov.in/

[3]. https://en.wikipedia.org/wiki/Space_research

[4]. http://www.qrg.northwestern.edu/projects/vss/docs/propulsion/2-what-are-the-types-of-rocket-propulsion.html

[5]. http://pubs.acs.org/doi/abs/10.1021/ie50556a017?journalCode=iechad

[6]. http://www.dtic.mil/dtic/tr/fulltext/u2/656567.pdf

[7]. https://www.nasa.gov/centers/johnson/pdf/584727main_Wings-ch4a-pgs157-181.pdf