

Loss in Earth Mass due to Extraterrestrial Space Exploration Missions

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Abstract- The big question is does Earth losing or gaining mass. This paper deals with the review of the research that Earth mass is decreasing due to the various reasons they are Hydrogen escape, Helium escape and loss due to nuclear radiation from Earth core. Mass loss due to space exploration missions cannot be neglected.

Similar to the pollution, pollution happen in many ways due to natural and human activities but pollution due to human activities is found to be more hazardous likely the earth loses mass due to natural phenomenon but loss due to human activity may be hazardous in future.

This paper gives the analysis of the space missions which lead to loss in Earth mass due to space missions.

Earth lost its mass of **about 3473 tons** in the infant space age of 53 years; it is found that Earth loses its mass with the **rate of 65.185 tons per year**.

Index Terms- Earth mass balance sheet, spacecraft, hydrogen escape, lunar module, and command module

I. INTRODUCTION

Usually when we talk about the Earth mass we say it is constant and has a value of 5.9736×10^{24} kg. When we look at the scenario we find that Earth must loose or gain mass due to effects like space dust falling in Earth or due to global warming etc. There are the various factors of Earth mass loss decrease or increase are Hydrogen Escape from the Earth atmosphere, Helium escape from Earth atmosphere, Space dust falling in, mass increase due to global warming, Energy loss due to nuclear reactions taking place inside Earth core and the loss of earth mass due to space missions.

Physicist and Cambridge University professor Dave Ansell to draw up a balance sheet of the mass that's coming in to the earth.

GAIN	IN TONS	LOSS	IN TONS
HYDROGEN ESCAPE	95000	SPACE DEBRIS FALLING	40000
HELIUM ESCAPE	1600	GLOBAL WARMING	160
RADIATION LOSSES	16		
NET LOSS OF EARTH MASS IS ABOUT 55000 TONS PER YEAR			

This balance sheet neglected the mass of earth loss due o the Space exploration missions. That should not be neglected. My work is the calculation of the space missions which lead to loss in Earth mass.

II. RESEARCH IDEA AND DATA COLLECTED

Physicist and Cambridge University professor Dave Ansell's balance sheet lead me to work on the mass loss study due to space missions. That research gave the point the space mission's usually fall back to Earth like Fobos Grunt.

This research work is studying only those space missions which lead to mass loss mean that are on other planet surface or at in the other planets gravitational field and are not returning back to Earth.

This mass loss contains the mass of spacecraft and the fuel taken with them, and the orbit insertion modules.

The research data is collected from different websites such as NSSDC catalogue, Gunturs space site, Russian space web etc and the masses are calculated and approximate rate of loss of earth mass due to these happenings is represented.

This research is the approximate analysis of the spacecraft masses.

STUDIES AND FINDINGS

This data collected came with findings that the total mass of the spacecrafts with their fuel had mass of about **263297 Kg**, mass of the lunar modules used in Apollo space missions fueled is in total **102872Kg**, total mass of the command modules of Apollo, Apollo-Soyuz and Skylab space missions in space with their fuel mass is in total **1798500Kg**, mass of lunar rover used in Apollo space missions with their payload is **14649Kg** in total, and mass of the Upper stages of rockets/orbit insertion modules like centaur, IUS, Blok D is about **1275556 Kg**. **The total of these masses is 3454874 Kg.**

On average it came to be 65.145 tons per year

This total mass is lost by the Earth in 53 years of the space age till 2012. Data is approximate calculation of spacecraft masses as the masses of various spacecraft shown by various websites.

TABLE NO. 2 EARTH MASS LOSS DUE TO SPACECRAFT LAUNCHES	
	TOTAL MASS IN KG
SMALL SPACECRAFT MASSES	263297
ORBIT INSERTION HARDWARE	1275556
LUNAR MODULE (APOLLO'S)	102872
COMMAND MODULES (APOLLO'S)	1798500
LUNAR ROVER WITH PAYLOAD	14649
	3454874

TABLE NO. 3 SMALL SPACECRAFT MASSES	MASS IN KG
LUNAR MISSIONS	101502
VENUS MISSIONS	55329
MARTIAN MISSIONS	64698
COMETS AND ASTEROIDS	9634
OUTER SOLAR SYSTEM PROBES	14492
SOLAR MISSIONS	7594
SPACE OBSERVATORIES AT L2	10048
TOTAL	263297

TABLE NO.4 LUNAR MODULES PRESENTLY ON LUNAR SURFACE		
MISSION	LUNAR MODULE	MASS IN KG
APOLLO 10	LM-4	14696
APOLLO 11	LM-5	14696
APOLLO 12	LM-6	14696
APOLLO 14	LM-8	14696
APOLLO 15	LM-10	14696
APOLLO 16	LM-11	14696
APOLLO 17	LM-12	14696
	TOTAL MASS OF LM	102872

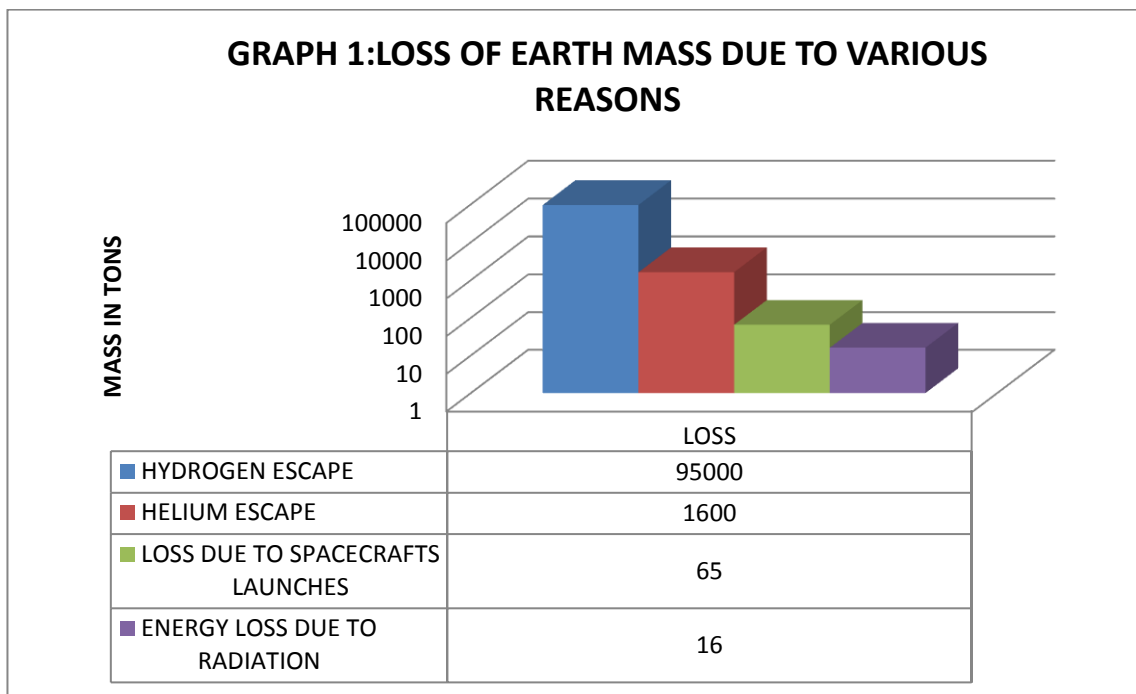
TABLE NO. 5 MASS OF COMMAND MODULES WHICH ARE NOT PRESENT ON EARTH			
MISSION	DESIGNATION	PRESENT LOCATION	MASS IN KG
APOLLO 7	S-IVB-205	SOLAR ORBIT	119900
SKYLAB 2	S-IVB-206	SOLAR ORBIT	119900
SKYLAB 3	S-IVB-207	SOLAR ORBIT	119900
SKYLAB 4	S-IVB-208	SOLAR ORBIT	119900
APOLLO SOYOUZ	S-IVB-210	SOLAR ORBIT	119900
APOLLO 8	S-1V-503	SOLAR ORBIT	119900
APOLLO 9	S-1V-504	SOLAR ORBIT	119900
APOLLO 10	S-1V-505	SOLAR ORBIT	119900
APOLLO 11	S-1V-506	SOLAR ORBIT	119900
APOLLO 12	S-1V-507	SOLAR ORBIT	119900
APOLLO 13	S-1V-508	LUNAR SURFACE	119900
APOLLO 14	S-1V-509	LUNAR SURFACE	119900
APOLLO 15	S-1V-510	LUNAR SURFACE	119900
APOLLO 16	S-1V-511	LUNAR SURFACE	119900
APOLLO 17	S-1V-512	LUNAR SURFACE	119900
		TOTAL	1798500

According to the plans of various space agencies for the future space missions it is found that if all is done success fully the numbers will be doubled in next fifty year or may be tripled.

III. CONCLUSION

From the upper data it is found that Earth mass is losing to 65.145 tons/year due to space missions it will be increasing time by time.

TABLE NO. 6 EARTH MASS BALANCE SHEET CONSIDERING SPACECRAFT MASS LOSS			
GAIN	IN TONS	LOSS	IN TONS
HYDROGEN ESCAPE	95000	SPACE DEBRIS FALLING	40000
HELIUM ESCAPE	1600	GLOBAL WARMING	160
SPACECRAFT LAUNCHES	65		
RADIATION LOSSES	16		
NET LOSS OF EARTH MASS IS ABOUT 56521 TONS PER YEAR			



APPENDIX

Appendixes, if needed, appear before the acknowledgment.

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We are thankful to the space websites giving such a precious data available, we are thankful to . www.nssdc.gsfc.nasa.gov, www.wikipedia.com, www.astronautix.com, www.russianspaceweb.com, www.space.skyrocket.de etc.

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