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Analysis of Effect of Acid & Alkali on the Strength of Concrete with Fly Ash

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ABSTRACT

This study investigates the impact of curing concrete in both acidic and alkaline water on its strength. Through comprehensive testing, the research aims to provide insights into how varying curing environments influence the structural integrity of concrete, offering valuable information for construction practices and durability considerations. The findings aim to enhance our understanding of concrete behaviour in diverse curing environments, contributing to the optimization of construction practices in varying water quality scenarios.

Now a days the effect on acid and base exposure on strength and durability of concrete through experimentation. Concrete cubes mix will be prepared and exposed to different concentration and Diluted solution of H_2So_4 and NaoH. For 7 & 28 days. Total of 18 cubes of Size 150mm×150mm×150mm are cast with M-20,M-30 &M-35 grades of Concrete cubes are cured in normal or acid, alkali solution for 7 and 28 days. The cured cubes are then tested for compressive testing machine to determine their compressive strength.

Keywords: Curing, Compressive Strength, Structural Integrity, Concrete, Durability, Environmental.

1. INTRODUCTION

The durability and strength of concrete are critical factors influencing the long-term performance of structures. Curing, a crucial phase in the concrete's early development, significantly affects its final properties. This study helps into the determination of concrete strength when subjected to curing in both acidic and alkaline water environments. Understanding how varying water chemistries impact concrete strength is essential for optimizing construction practices, ensuring structural integrity, and addressing challenges posed by diverse curing conditions.

Concrete, as a fundamental construction material, undergoes a complex process of hydration and hardening during curing, influencing its mechanical properties. The choice of curing conditions, particularly in environments with acidic or alkaline water, introduces unique challenges and opportunities. Acidic and alkaline environments can alter the chemical reactions within the concrete matrix, potentially affecting its strength and durability. By systematically investigating the effects of varying pH levels on concrete specimens.

1.1 OBJECTIVES

The following objectives are proposed to achieve the aim.

a) An extension literature survey particularly subjected to chemical attack of materials.

b) Determination of effect of acids and base on compressive strength of concrete through experimentation.
c) Determination of behavior of acid and base in concrete cube.

1.2 NEED FOR STUDY

This study becomes more important in following cases.

- For sewer pipes
- Industrial effluent flowing through concrete channels.
- Chemical industry
- Dairy industry
- Kitchen waste flowing through concrete pipes
- Many industries like fertilizer manufacturing, storage plants, leather industry, and hospital waste etc.

2. METHODOLOGY

In the work M-20, M-30 & M-35 Grade concrete used with 25% replacement of Fly ash in cement.

CONCRETE MIX DESIGN

M-20 (1:1.5:3)

Volume of cube = (150×150×150) mm
= 0.003375 m^3
Wet volume = 1.54 ×dry volume
= 0.0051975 m^3
Cement = 1.30608 kg
Sand = 2.2708 kg
Aggregate =2.2708 kg
Quantity of water = water cement ratio = 0.45

M- 30 (1:1.46:2.26)

Cement= 1.585 kg
Sand = 2.5755 kg
Aggregate = 4.106kg
Quantity of water = water cement ratio = 0.45

Details of Experimentation

Complete immersion in solution

Table-2.1

Curing period	Normal cube (normal water curing)	Type of Acid	% of Acid	No of cubes	Type of Alkali	% of Alkali	No of cubes
7 days	3	H_2so_4	20%	3	NaoH	20%	3
28 days	3	H_2so_4	20%	3	NaoH	20%	3

3. RESULT AND DISCUSSION

M- 20 grade concrete compressive strength at 7 & 28 days.

Table – 3.1 M-20
Grade (H_2So_4)

Normal 7 day	Diluted 7 day (20% acid solution)	Concentrated 7 day (80% Alkali solution)	Normal 28 day	Diluted 28day (20% acid solution)	Concentrated 28 day (80% Alkali solution)
13.5	8.45	6.5	21.2	15.67	8.4
12.9	8.4	6.78	20.5	14.7	7.3
13.7	9.9	5.5	21.5	14.2	8.6

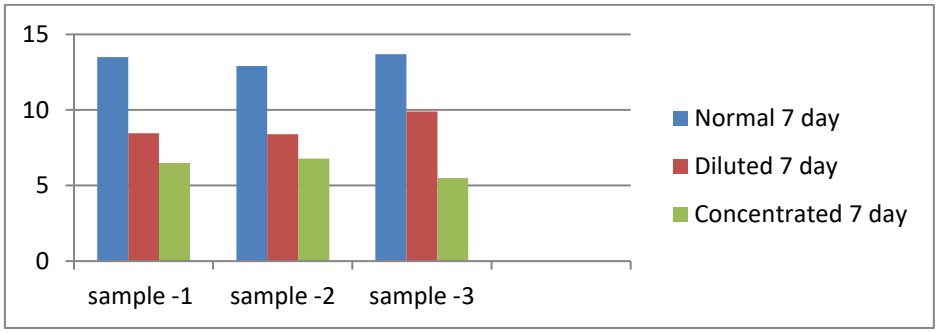

Fig- 3.1 M- 20 grade concrete compressive strength at 7 day (H_2So_4) solution

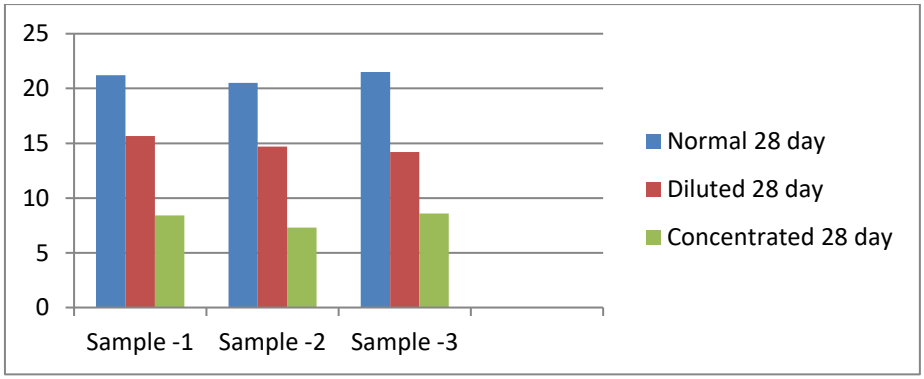

Fig- 3.2 M- 20 grade concrete compressive strength at 28 day ((H_2So_4) solution

After immersion of cubes in 7 & 28 days of curing, the strength of concrete cube reduces by 7& 13MPa strength compared to normal cube.

Table- 3.2 M- 20 grade concrete compressive strength at 7 & 28 day (NaoH solution)
M-20 Grade (NaoH)

Normal 7 day	Diluted 7 day (20% Alkali solution)	Concentrated 7 day (80% Alkali solution)	Normal 28 day	Diluted 28day (20% Alkali solution)	Concentrated 28 day (80% Alkali solution)
13.5	8.4	6.5	21.2	15.6	8.4
12.9	8.45	6.7	20.5	14.6	7.5
13.7	9.91	5.4	21.5	14.3	8.4

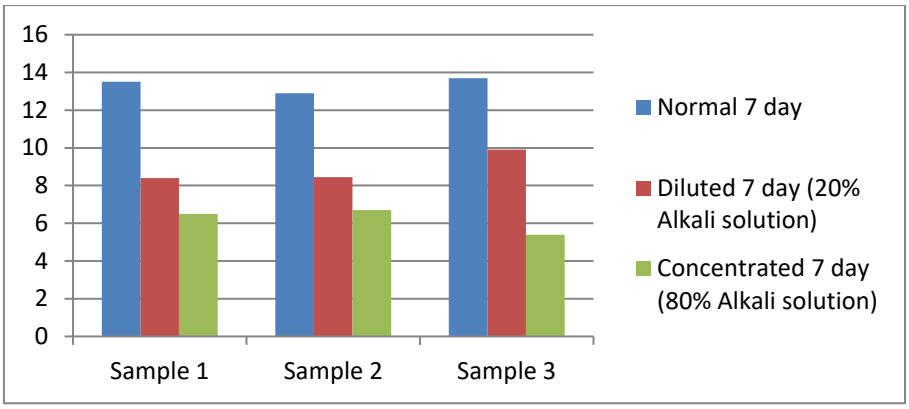

Fig- 3.3 M- 20 grade concrete compressive strength at 7 day (NaoH solution)

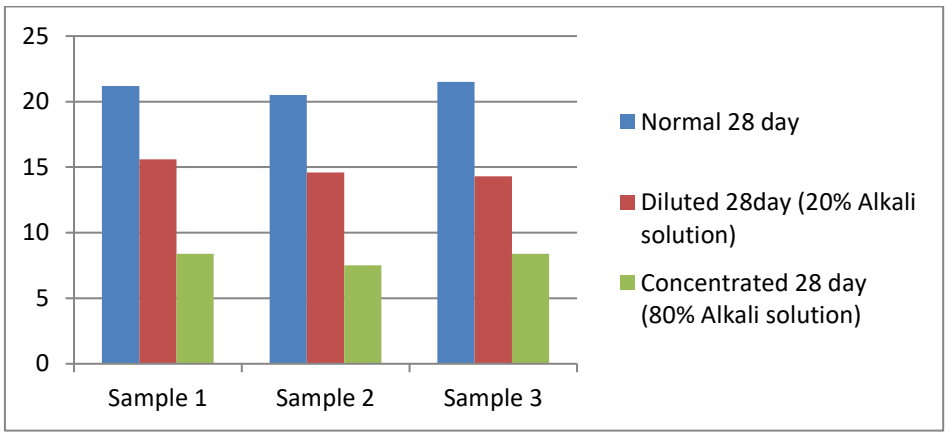

Fig- 3.4 M- 20 grade concrete compressive strength at 28 day (NaoH solution)

Table – 3.3

M-30 grade concrete compressive strength at 7 & 28 days (H_2So_4 acid solution).

Normal 7 day	Diluted 7 day (20% acid solution)	Concentrated 7 day (80% H_2So_4)	Normal 28 day	Diluted 28 day (20% acid solution)	Concentrated 28 day (80% H_2So_4)
21	20.45	18.5	29.81	28.91	25.67
20.9	20.5	18.2	30.1	29.6	26.9
21.5	20.9	17.98	30	29.7	25.7

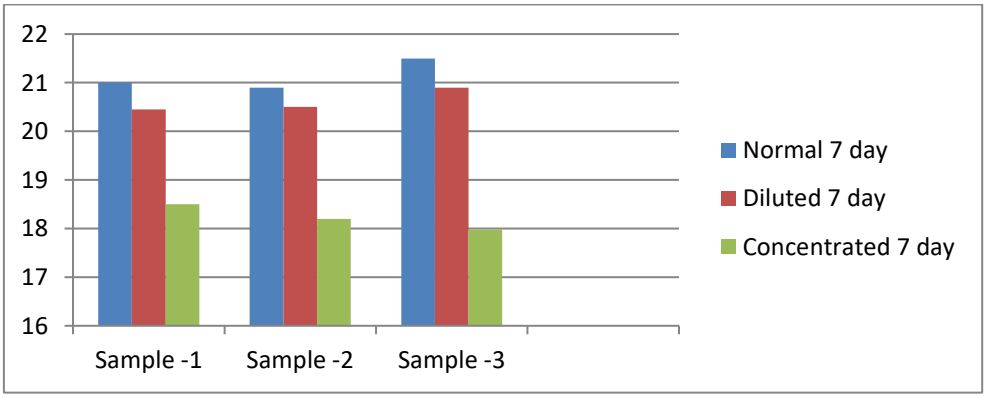

Fig- 3.5 M- 30 grade concrete compressive strength at 7 day ((H_2So_4) solution

Fig- 3.5 M-30 grade concrete cubes

M- 30 grade concrete compressive strength at 7 day ((H_2So_4) solution

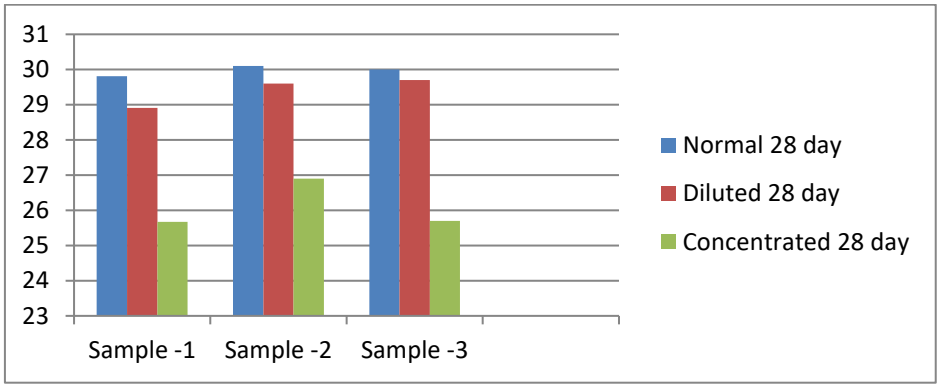

Fig- 3.6 M- 30 grade concrete compressive strength at 28 day ((H_2So_4) solution

After immersion of cube in 7 & 28 days of curing, the strength of concrete cube reduces by 3 & 4.5MPa strength compared to normal cube.

Table – 3.4

M-30 grade concrete compressive strength at 7 & 28 days (NaoH acid solution).

Normal 7 day	Diluted 7 day (20% alkali NaoH solution)	Concentrated 7 day (80% NaoH)	Normal 28 day	Diluted 28 day (20% alkali NaoH solution)	Concentrated 28 day (80% NaoH)
21.1	20.4	18.5	29.8	28.9	25.6
20.8	20.5	18.4	30.2	29.6	26.9
21.6	20.7	17.9	30.2	29.5	25.7

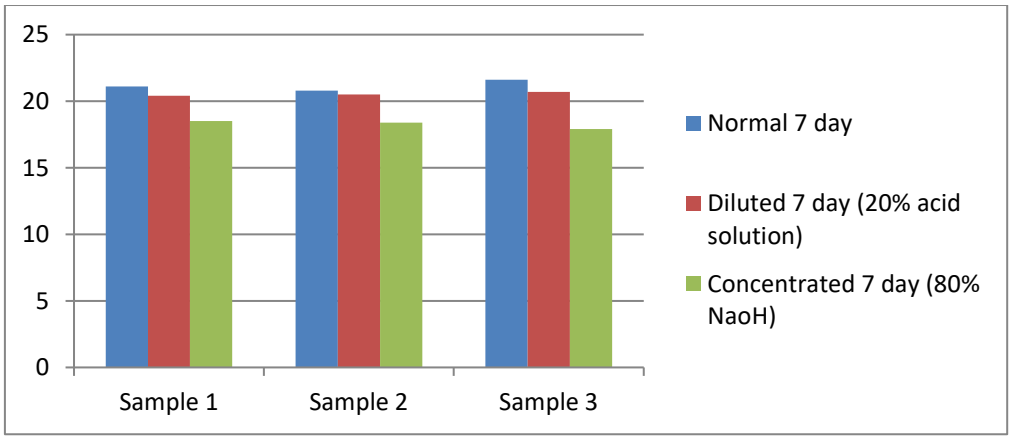

Fig-3.7 M-30 grade concrete compressive strength at 7 day (NaoH)

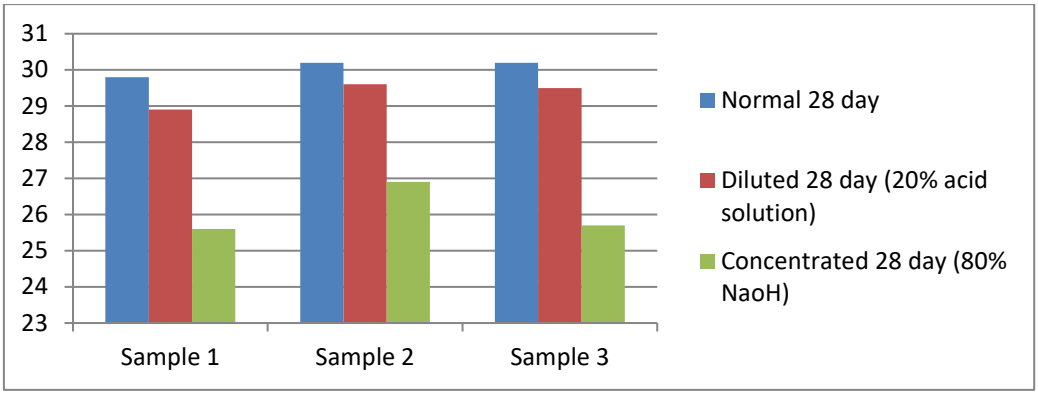

Fig-3.8 M-30 grade concrete compressive strength at 7 day (NaoH)

Table – 3.5

M-35 grade concrete compressive strength at 7 & 28 days (H_2So_4 acid solution).

Normal 7 day	Diluted 7 day (20% acid solution)	Concentrated 7 day (80% acid solution)	Normal 28 day	Diluted 28 day(20% acid solution)	Concentrated 28 day (80% acid solution)
23.4	23.2	20.2	35.2	34.89	29.4
23	22.89	20	35	34.6	27.1
23.5	22.1	21.06	34.89	34	25.89

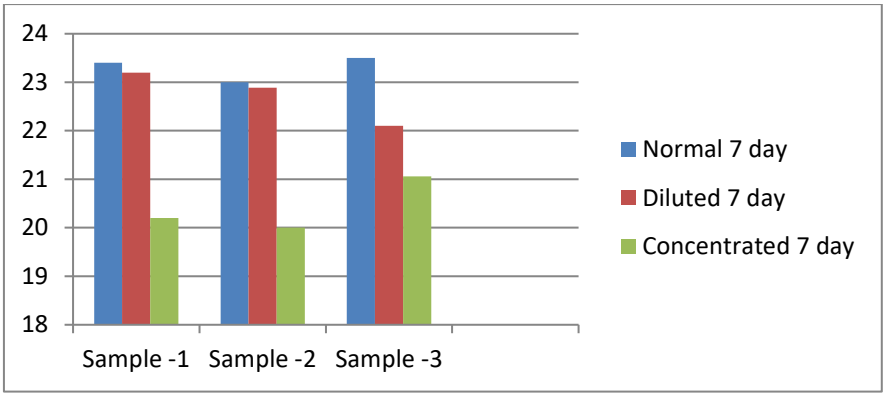

Fig-3.9 M-30 grade concrete compressive strength at 7 day (H_2so_4)

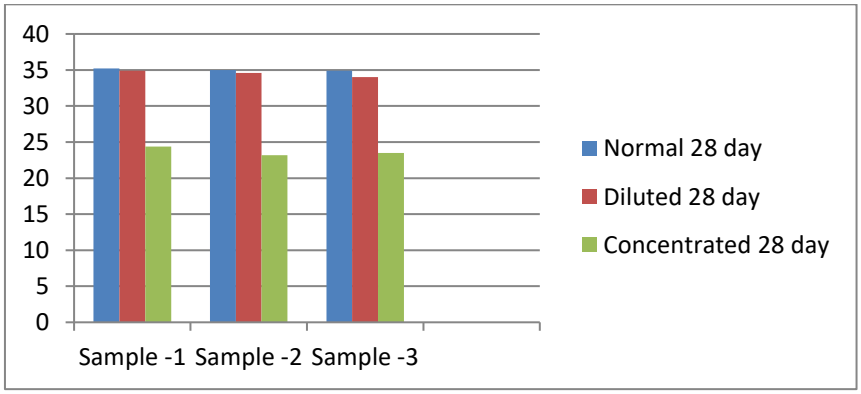

Fig-3.10 M-30 grade concrete compressive strength at 28 day (H_2so_4)

After immersion of cubes in 7 & 28 days of curing, the strength of concrete cube reduces by 2 &6MPa strength compared to normal cube.

Table – 3.6

M-35 grade concrete compressive strength at 7 & 28 days (NaoH alkali solution).

Normal 7 day (Normal water)	Diluted 7 day (20% alkali solution)	Concentrated 7 day (80% alkali solution)	Normal 28 day (Normal water)	Diluted 28 day(20% alkali solution)	Concentrated 28 day (80% alkali solution)
23.5	23.2	20.2	35.2	34.8	29.5
23	22.8	20.1	35.3	34.6	27.2
23.6	22.4	21.6	34.9	34.2	25.8

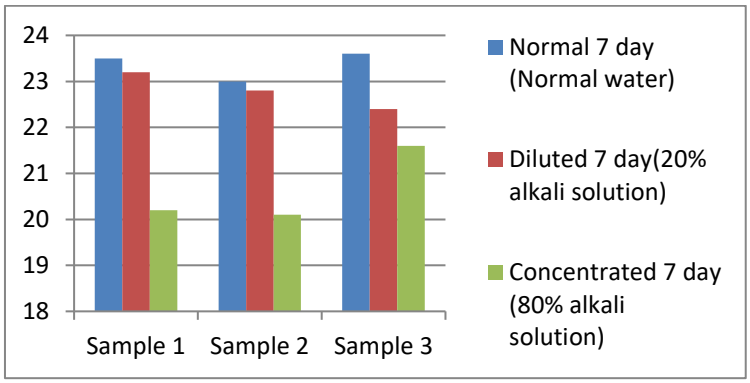

Fig- 3.11 M-35 grade concrete compressive strength at 7 day (NaoH solution)

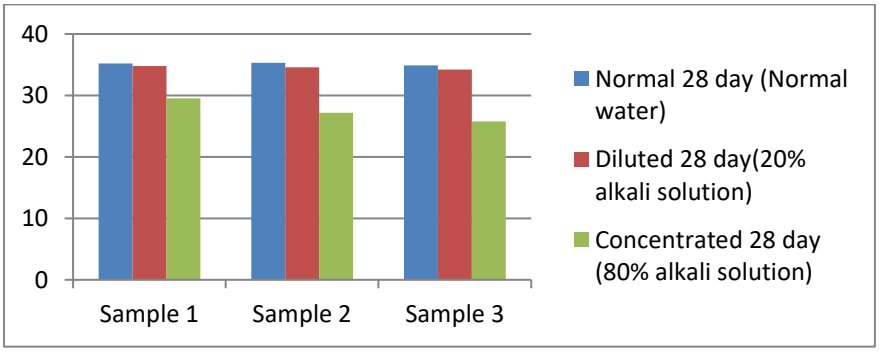

Fig- 3.12 M-35 grade concrete compressive strength at 28 day (NaoH solution)

After removal of cubes from H_2So_4 and NaoH solution slight change in the colour of cubes Light whitish colour is visible on the surface of the cube. Also reduce the strength and durability.

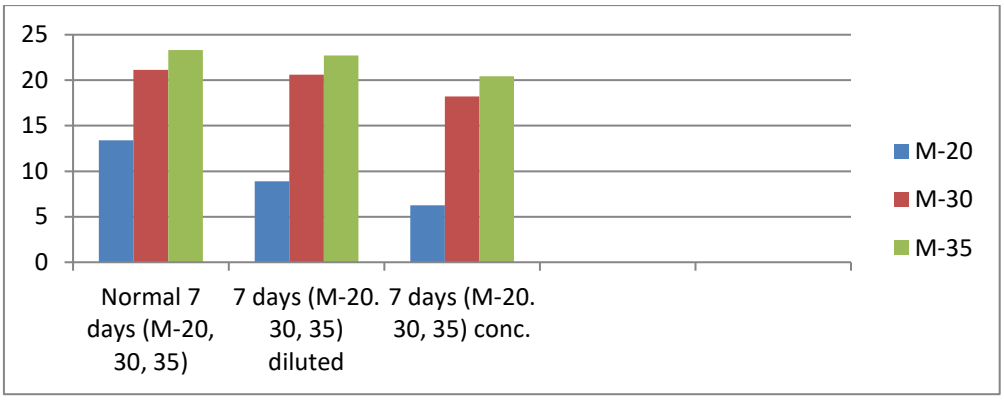

Fig- 3.13 M-20,30,35 Compressive strength test H_2So_4 and NaoH solution (7 days)

Fig- 3.14 M-35 grade concrete cubes

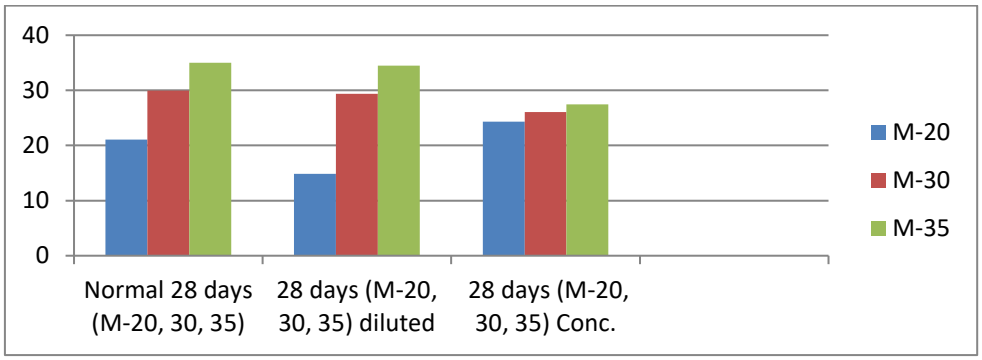

Fig- 3.15 M-20,30,35 Compressive strength test H_2So_4 and NaoH solution (28 days)

4. CONCLUSION

Acidic and alkaline water can adversely affect the strength and durability of concrete. Its greater effect is seen in lower grade of concrete. It has minor effect on the higher grade of concrete. In sewage tank& sewer pipeline construction, sea water areas we can use higher grade of concrete. The decreases in strength and durability of concrete increase with both curing age and percentage of Concentration of acid and alkaline as a curing water. A linear relationship exists between loss in weight and strength as the percentage of acid and alkali Increases.

Concrete structure are setup in this type of environment so special attention to be needed in design of mix proportion of concrete, use higher grade of concrete or factored of safety, use special admixtures, plasticizers to helps reduction in chemical reactions. Alkali and Acidic solution gives approximately same result at 7 & 28 days compressive strength of cube sample. So we can conclude that the behaviour of acid and alkali effect on concrete is same.

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