Project:

Use of
Metakaoline and Alccofine as a admixture in concrete.

Group detailes :

- **Group ID 1300011141**

- **Name of students:**
  - **Prajapati Bhavik– 100780106042**
  - **Patel Ilesh -100780106026**
  - **Patel Kunj – 100780106015**
  - **Prajapati Mehu-110783106012**

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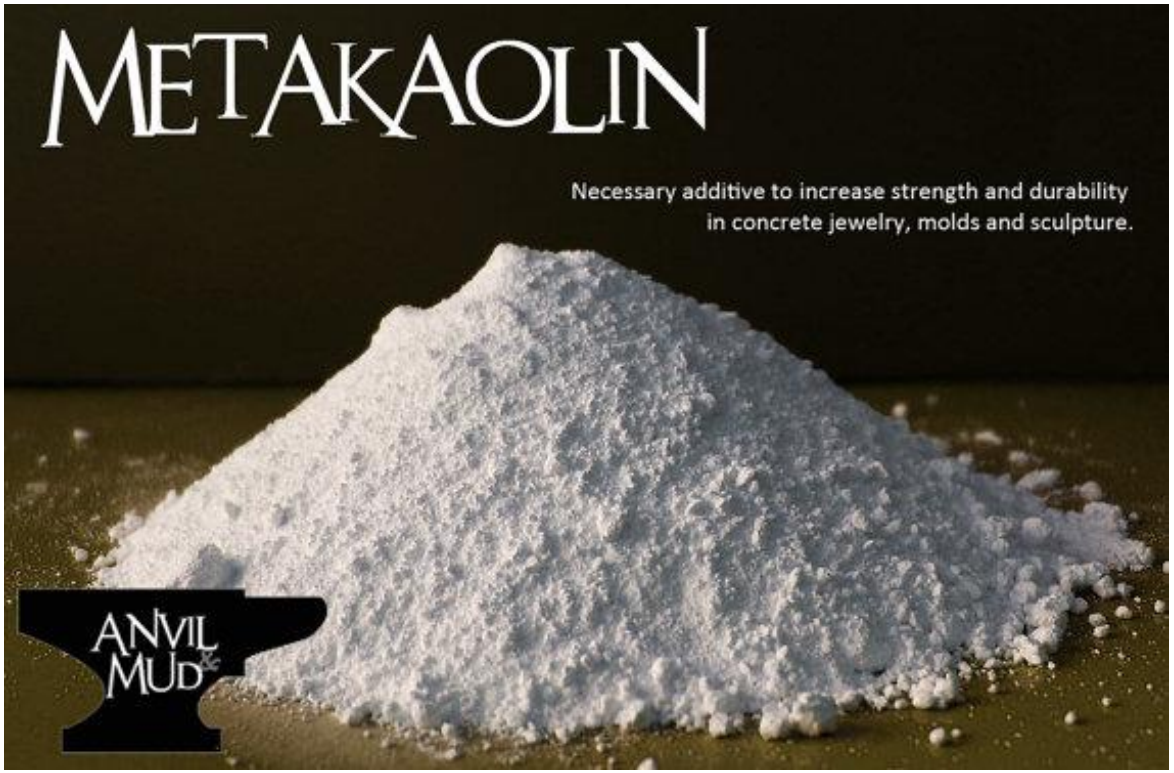
INTRODUCTION

Metakaolin:


METAKAOLIN
Necessary additive to increase strength and durability
in concrete jewelry, molds and sculpture.
ANVIL & MUD

What is Metakaolin??:

- Metakaoline is dehydroxylated from the clay mineral kaolinite.
- Rocks that are rich in kaolinite are known as china clay or kaolin, traditionally used in the manufacture of porcelain. The particle size of metakaolin is smaller than cement particles, but not as fine as silica fume.

Concrete application:

- Considered to have twice the reactivity of mostother pozzolans, metakaolin is a valuableadmixture for concrete/cement applications. Replacing portland cement with 0–20% (by weight) metakaolin produces a concrete mix, which exhibits favorable engineering properties, including: the filler effect, the acceleration of OPC hydration, and the pozzolanic reaction. The filler effect is immediate, while the effect of pozzolanic reaction occurs between 3 to 14

Advantages:

- Increased compressive and flexural strengths.
- Reduced permeability (including chloride permeability).
- Increased resistance to chemical attack.
- Increased durability.
- Reduced effects of alkali-silica reactivity (ASR) .
- Enhanced workability and finishing of concrete.
- Reduced shrinkage, due to "particle packing" making concrete denser.
- Improved color by lightening the color of concrete making it possible to tint lighter integral color.

Uses of metakaolin:

- High performance, high strength, and lightweight concrete.
- Precast and poured-mold concrete .
- Fibercement and ferrocement products.
- Glass fiber reinforced concrete. Countertops, art sculptures (see for example the free-standing sculptures of Albert Vrana) .
- Mortar and stucco.

Broad Contemporary Art Museum - Los Angeles

ALCCOFINE

About of Alccofine:

- ALCCOFINE 1203 is a new generation, ultrafine, low calcium silicate product, manufactured in India.
- It has distinct characteristics to enhance 'performance of concrete' in fresh and hardened stages.
- It can be considered and used as practical substitute for Silica Fume as per the results obtained.
- If the advantages of ALCCOFINE 1203 are observed in the concrete mix design, the initial rate of strength development was found to be increased or similar as that of Silica Fume

Features and Benefits

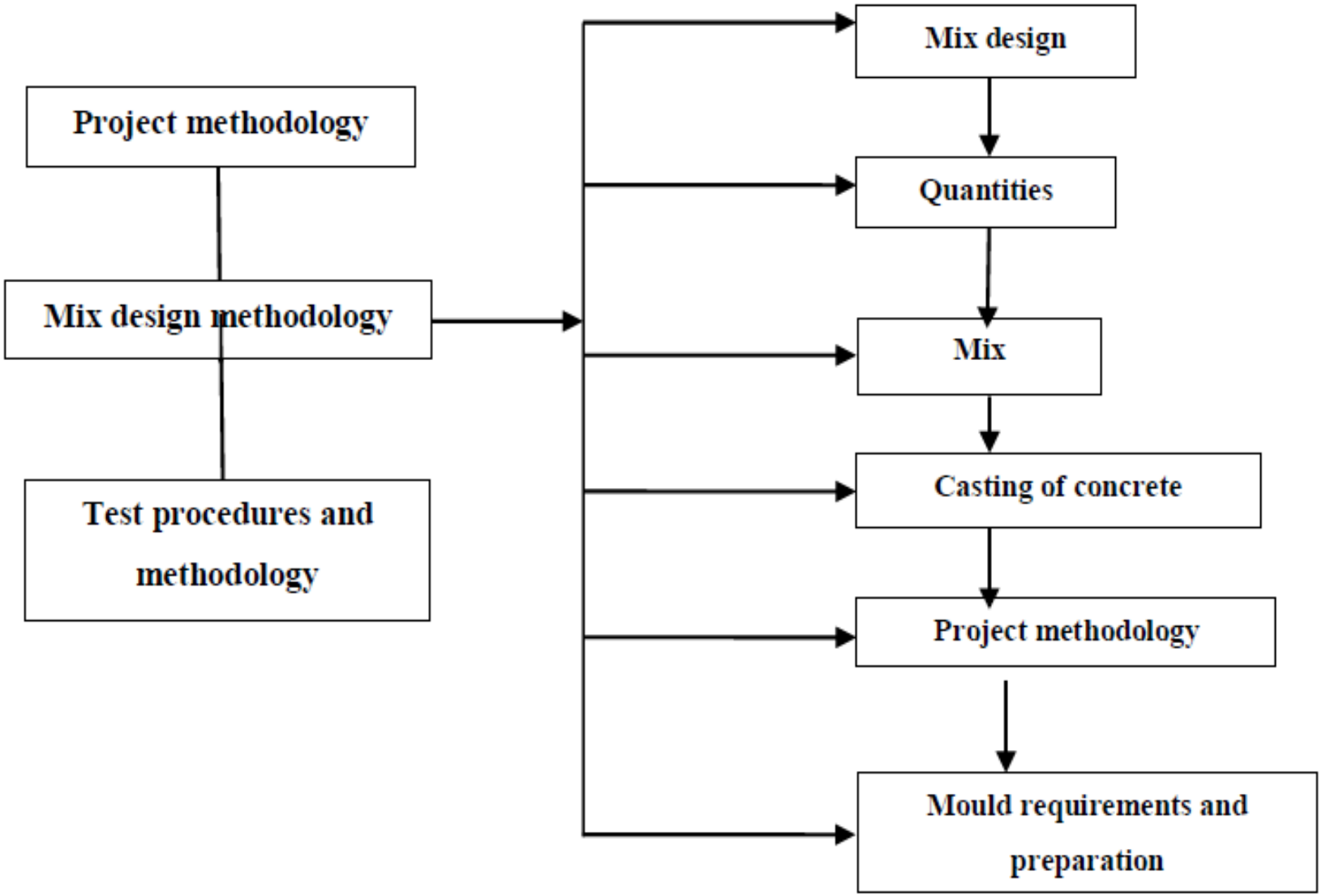
- • Standard cement injection equipment can be used.
  • Better penetration in tight joints, fissures and pore spaces.
  • Greater penetration imparts greater water tightness
  • Fast setting.
  • Better working environment and no hazardous. Components.
  • Durable.
  • Economical solution.

Diemer Water Filtration Plant

OBJECTIVES:

- To Improve compressive strength and workability of the concrete by use of metakaolin.
- To Improve cementities properties.
- To Improve durability of concrete.
- To Improve fire resistance of concrete

Methodology



Chemical composition and color of cementitious materials.

Chemical composition	cement	metakaolin
Sio2	21%	51.2%
Al2o3	5.2%	45.3%
Fe2o3	2.3%	0.60%
mgo	3.9%	-
cao	63.9%	0.05%
Na2o	0.5%	0.21%
K2o	0.5%	0.16%
So3	2.4%	-
LOI	-	0.51%
Color	gray	white

ACI MATERIALS JOURNAL
by Jian-Tong Ding and Zongjin Li

Litreture review.

Compressive Strength and Chloride Resistance of Metakaolin Concrete

G. Dhinakaran*, S. Thilgavathi**, and J. Venkataramana

- In the present research work, investigations were carried out to improve the performance of concrete in terms of strength and resistance to chloride-ion-penetration by The study was conducted for different water-to-cement metakaolin ratio (w/cm) ratios of 0.32, 0.35, 0.4 and 0.5. The MK proportion was varied from 0 to 15% with an increment of 5% and ages of concrete from 3 to 90 days were considered andexperiments performed accordinglyincorporating metakaolin (MK) as mineral admixture in concrete.
- From the results, it was observed that MK concrete showed greater strength for higher w/cm ratios (0.4 and 0.5) and its resistance tochloride ion penetration was more or less consistent for all w/cm ratios and the optimal amount of MK resulted significant reduction in chloride ion penetration

Effects of Metakaolin and Silica Fume on Properties of Concrete

by Jian-Tong Ding and Zongjin Li

- *Metakaolin-modified concrete showed a better workability than silica fume-modified concrete. As the replacement level was increased, the strength of the metakaolin-modified concrete increased at all ages similarly to that of the silica fume-modified concrete.*

Improving strength, drying shrinkage, and pore structure of concrete using metakaolin.

Erhan Gu¨neyisi Æ Mehmet Gesog˘lu Æ Kasım Mermerdas.

- The results revealed that the inclusion of MK remarkably reduced the drying shrinkage strain, but increased the strengths of the concretes in varying magnitudes, depending mainly on the replacement level of MK, w/cm ratio, and age of testing. It was also found that the ultrafine MK enhanced substantially the pore structure of the concretes and reduced the content of the harmful large pores, hence made concrete more impervious, especially at a replacement level of 20%.

Strength and Durability Properties of High Performance Concrete incorporating High Reactivity Metakaolin .

B. B. Patil1, P. D. Kumbhar

The present paper deals with the study of properties namely workability, compressive strength and durability of M60 grade HPC mixes incorporating different percentages of high reactivity metakaolin by weight of cement along with some suitable super plasticizer .

The results of the study indicate that the workability and strength properties of HPC mixes improved by incorporating HRM up to a desirable content of 7.5% by weight of cement.

2.1.5 Effect of Alccofine and Fly Ash Addition on the Durability of High Performance Concrete Yatin Patel1, Dr. (Smt.) B. K. Shah2, Prof. P. J. Patel3 *IJSRD - International Journal for Scientific Research & Development*| *Vol. 1, Issue 3, 2013* | *ISSN (online): 2321-0613*

The aim of this Study is to evaluate the performance of

concrete (HPC) containing supplementary cementitious materials such as Fly ash &Alccofine. The necessity of high performance concrete is increasing because of

demands in the construction industry. Efforts for improving the performance of concrete over the past few years suggest that cement replacement materials along with Mineral & chemical admixtures can improve the strength and durability characteristics of concrete. Alccofine (GGBS) and Fly ash are pozzolanic materials that can be utilized to produce highly durable concrete composites.

Procedure

- Concrete Mix Design - M20 (1: 1.5 : 3)
- Replacement Criteria-:
- (% Replacement With Respect To Fine Aggregate)
  - 0 %
  - 10 %
  - 20 %
  - 30 %
  - 40%
- Sample Will Be Tested After Curing Period Of 3 Days, 7 Days And 28 Days.

Cement

- Cement is a fine, grey powder. Cement is mixed with water and materials such as sand, gravel, and crushed stone to make concrete.
- The cement and water form a paste that binds the other materials together as the concrete hardens.
- The most commonly used cement is called ordinary Portland cement.
- Ordinary Portland cement of different grades OPC-33, OPC-43 and OPC-53 are available in the market and are generally used.
- In this work cement of 53 grade was used for casting cubes for all concrete mixes.

Chemical Composition of metakaoline.

Chemical composition	Cement	Metakaolin
Sio2	21%	51.2%
Al2o3	5.2%	45.3%
Fe2o3	2.3%	0.60%
Mgo	3.9%	-
Cao	63.9%	0.05%
Na2o	0.5%	0.21%
K2o	0.5%	0.16%
So3	2.4%	-
LOI	-	0.51%

Properties of alccofine.

- As can be seen in the chemical composition and physical characteristics listed in Table 1, ALCCOFINE
- 1203 has got the unique chemical composition mainly of CaO 30-34% and SiO
- 30-36%. Physically the
- product is unique with regards to its particle size distribution. Figure: 1, demonstrates the
- comparative particle size distribution analysis.

CHARACTERISTICS AND PROPERTIES

Chemical Analysis	Mass %	Physical analysis	Range
CaO	30-34	Bulk Density	600-700 kg/m3
Al2O3	18-25	Surface Area	12000 cm2/gm
Fe2O3	0.8-3.0	Particle shape	Irregular
SO3	0.1-0.4	Particle Size, d10	< 2 µm
MgO	6-10	d50	< 5µm
SiO2	30-36	d90	< 9 µm

Mix Design

- All the samples were prepared using design M20 grade of concrete. Mix design was done based on I.S 10262-1982. The Table below show mix proportion of concrete (Kg/m3).

Sr. No	Material	Quantity (Kg/m3)
1.	Cement (OPC)	383
2.	Fine Aggregate	642
3.	Coarse Aggregate	1142
4.	Water	191.6

Following test will be conducted -:

- Split tensile strength test
- Flexural strength test
- Compressive strength test

Test On Concrete

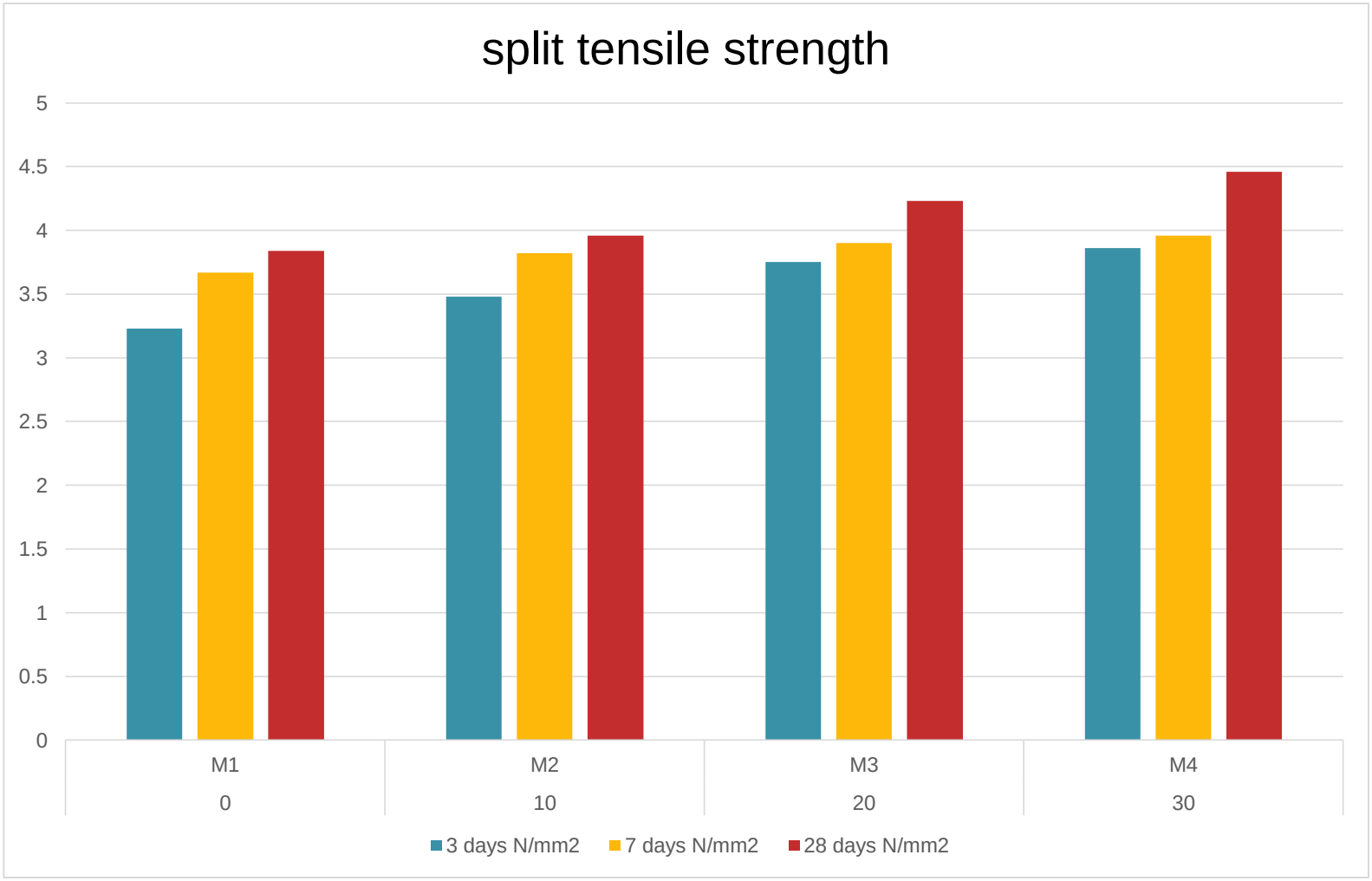
- **SPLIT TENSILE STRENGTH**
- Tensile strength is an important property of concrete because concrete structures are highly vulnerable to tensile cracking due to various kinds of effects and applied loading itself.

- However, tensile strength of concrete is very low in compared to its compressive strength. This test could be performed in accordance with IS : 5816-1970.

FIG: Split Tensile Strenth

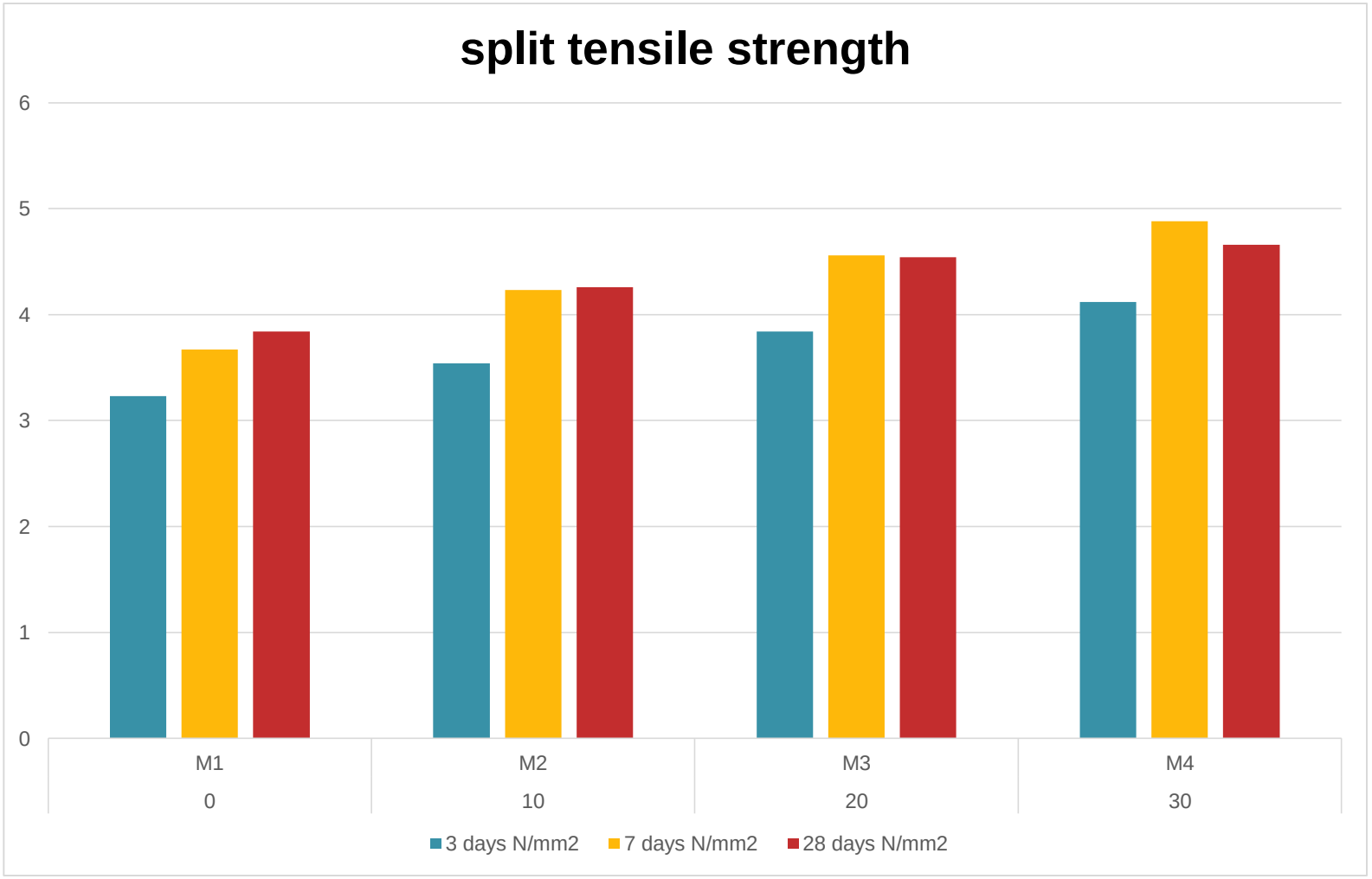
❖ Split tensile strength test result of metakaoline.

MK Content %	Mix	3 days N/mm2	7 days N/mm2	28 days N/mm2
0	M1	3.23	3.67	3.84
10	M2	3.48	3.82	3.96
20	M3	3.75	3.90	4.23
30	M4	3.86	3.96	4.46


split tensile strength
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
M1
0
M2
10
M3
20
M4
30
3 days N/mm2
7 days N/mm2
28 days N/mm2

❖split tensile strength test result of alccofine.

ALC Content %	Mix	3 days N/mm2	7 days N/mm2	28 days N/mm2
0	M1	3.23	3.67	3.84
10	M2	3.54	4.23	4.26
20	M3	3.84	4.56	4.54
30	M4	4.12	4.88	4.66


split tensile strength
6
5
4
3
2
1
0
M1
0
M2
10
M3
20
M4
30
3 days N/mm2
7 days N/mm2
28 days N/mm2

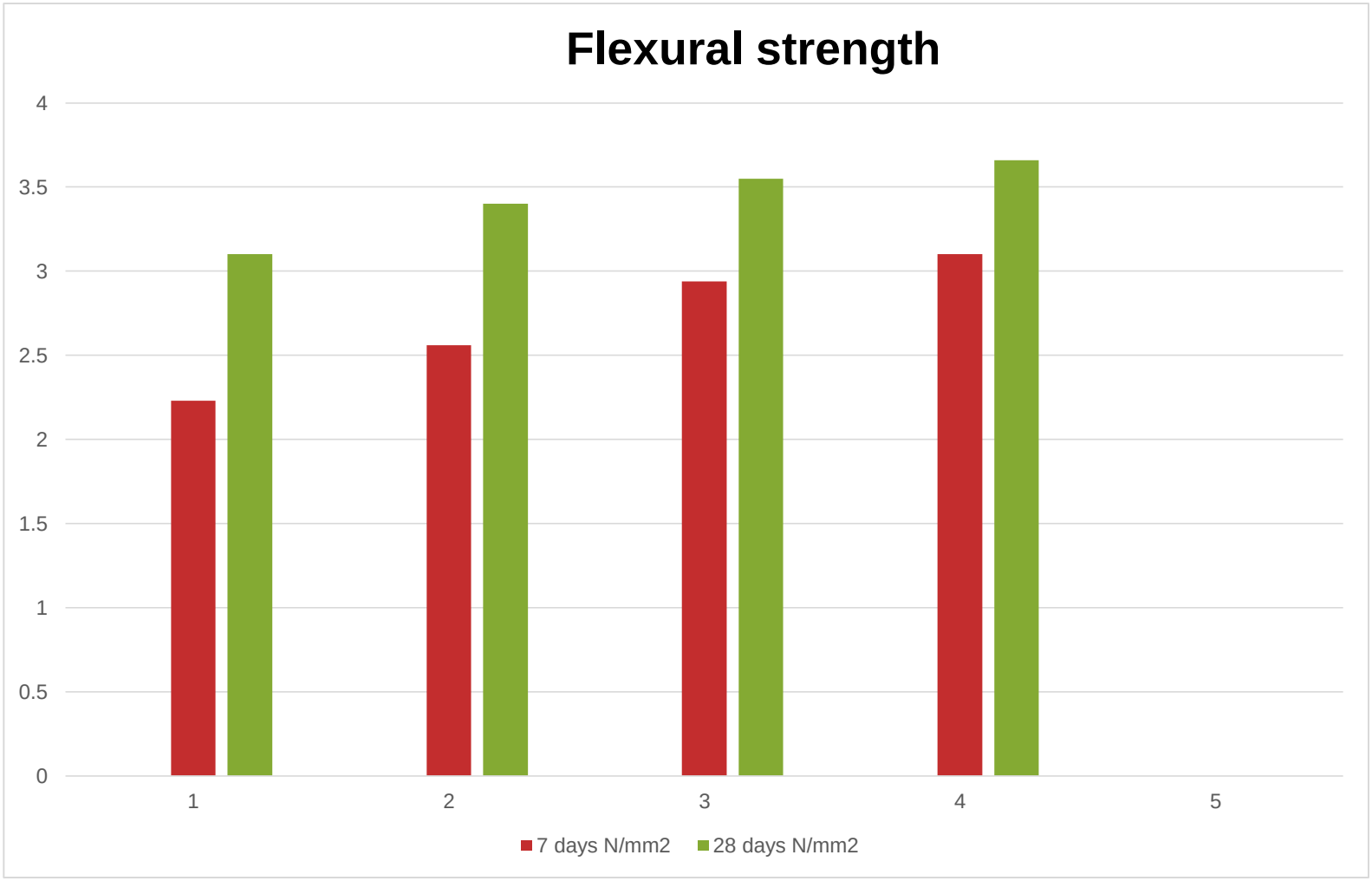
- **FLEXURAL STRENGTH**

- ✓ Flexural strength, also known as modulus of rupture, bend strength, or fracture strength mechanical parameter for brittle material, is defined as a material's ability to resist deformation under load. The transverse bending test is most frequently employed, in which a specimen having either a circular or rectangular cross-section is bent until fracture or yielding using a three point flexural strength technique. The flexural strength represents the highest stress experienced within the material at its moment of rupture. It is measured in terms of stress.

Fig : Flexure Testing Machine

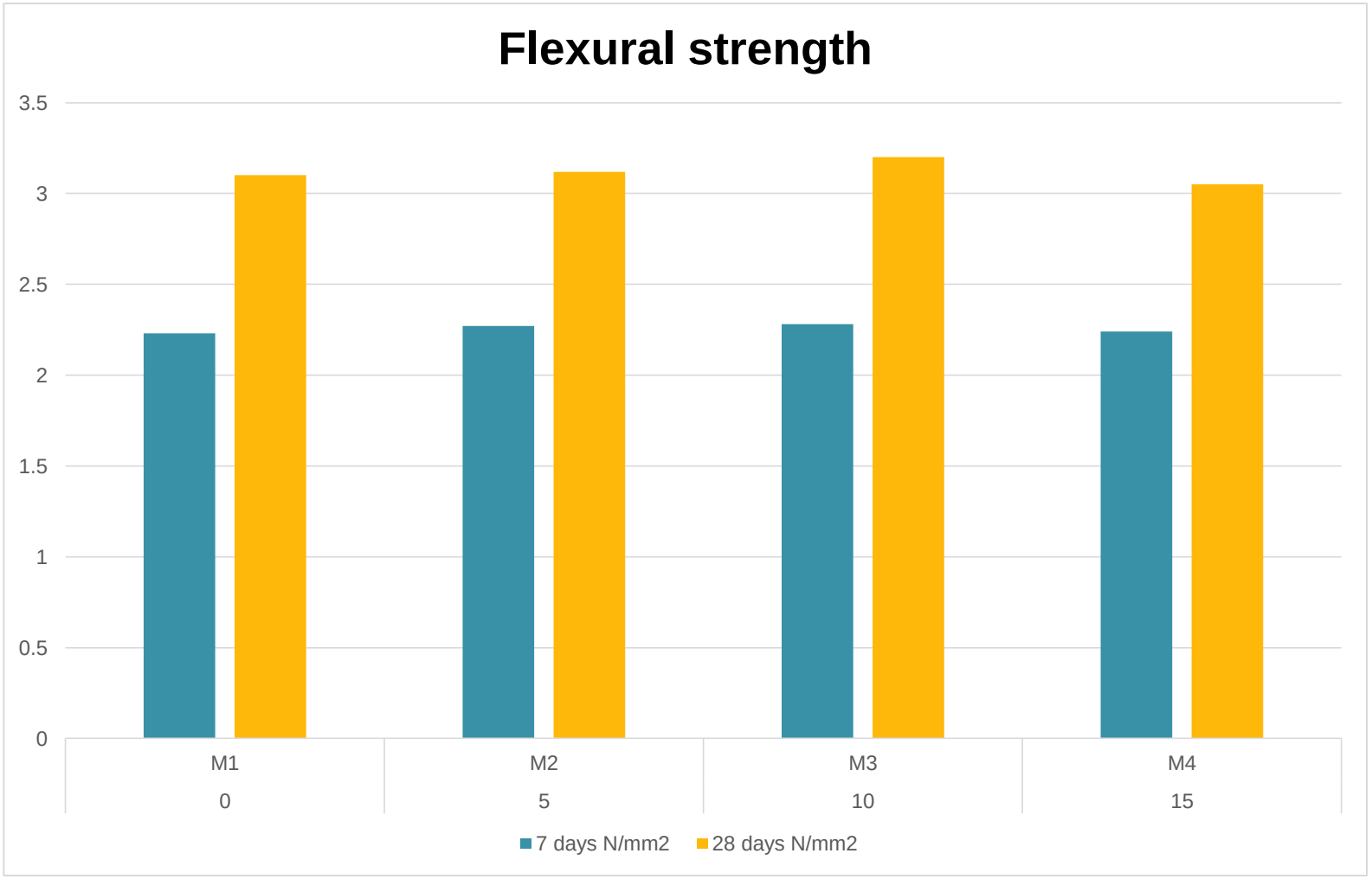
❖flexural strength test result of metakaoline.

MK Content %	Mix	7 days N/mm2	28 days N/mm2
0	M1	2.23	3.10
5	M2	2.56	3.40
10	M3	2.94	3.55
15	M4	3.10	3.66


Flexural strength
4
3.5
3
2.5
2
1.5
1
0.5
0
1
2
3
4
5
7 days N/mm2
28 days N/mm2

flexural strength test result of alccofine

ALC Content %	Mix	7 days N/mm2	28 days N/mm2
0	M1	2.23	3.1
5	M2	2.27	3.12
10	M3	2.28	3.20
15	M4	2.24	3.05


Flexural strength
3.5
3
2.5
2
1.5
1
0.5
0
M1
0
M2
5
M3
10
M4
15
7 days N/mm2
28 days N/mm2

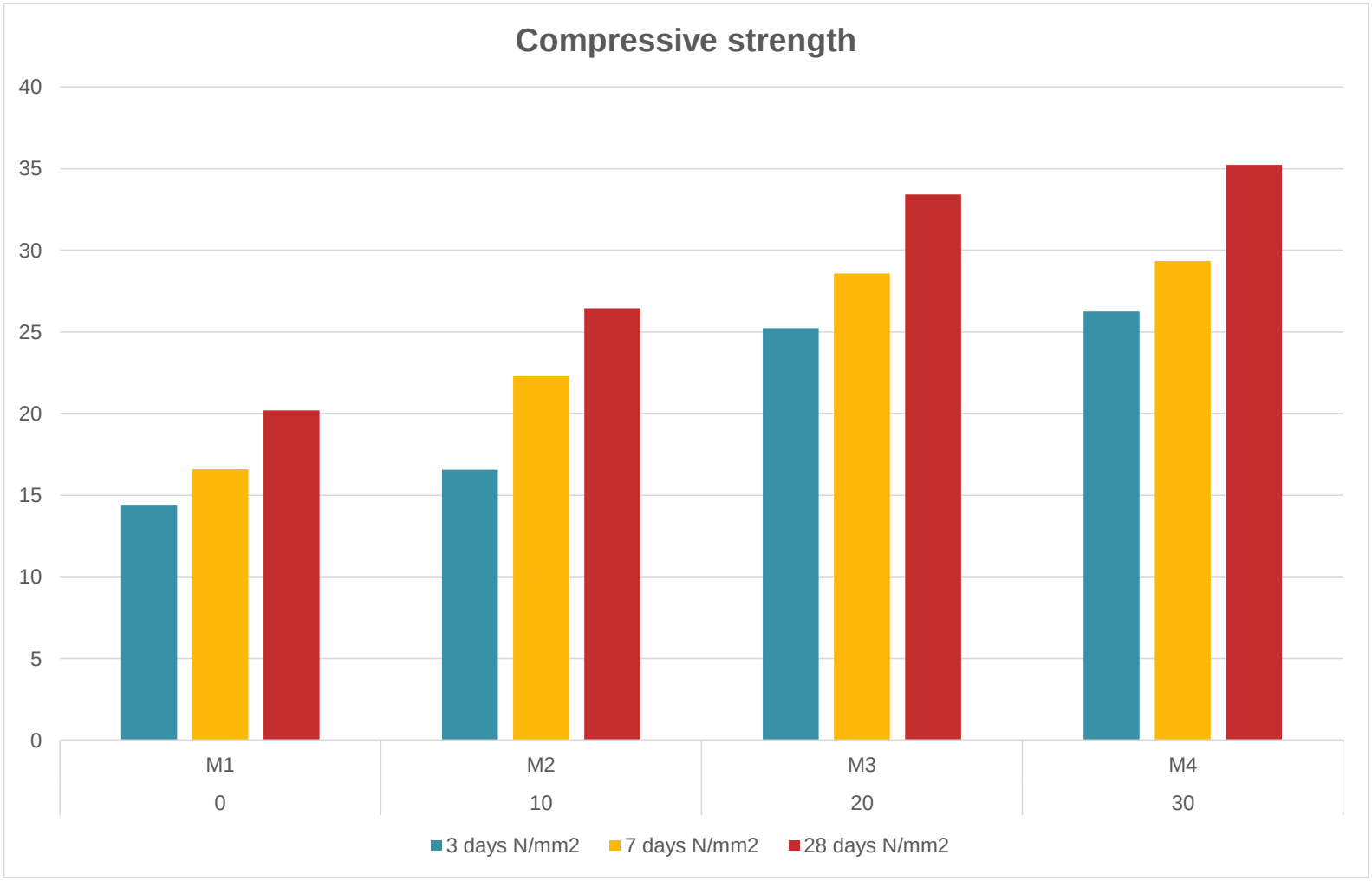
- **3 :COMPRESSIVE STRENGTH**

  In the study of strength of material, the compressive strength is the capacity of a material or structure to withstand loads tending to reduce size. It can be measured by plotting applied force against deformation in a testing machine. Some material fracture at their compressive strength limit; others deform irreversibly, so a given amount of deformation may be considered as the limit for compressive load. Compressive strength is a key value for design of structures.

Fig: Compressive Strength

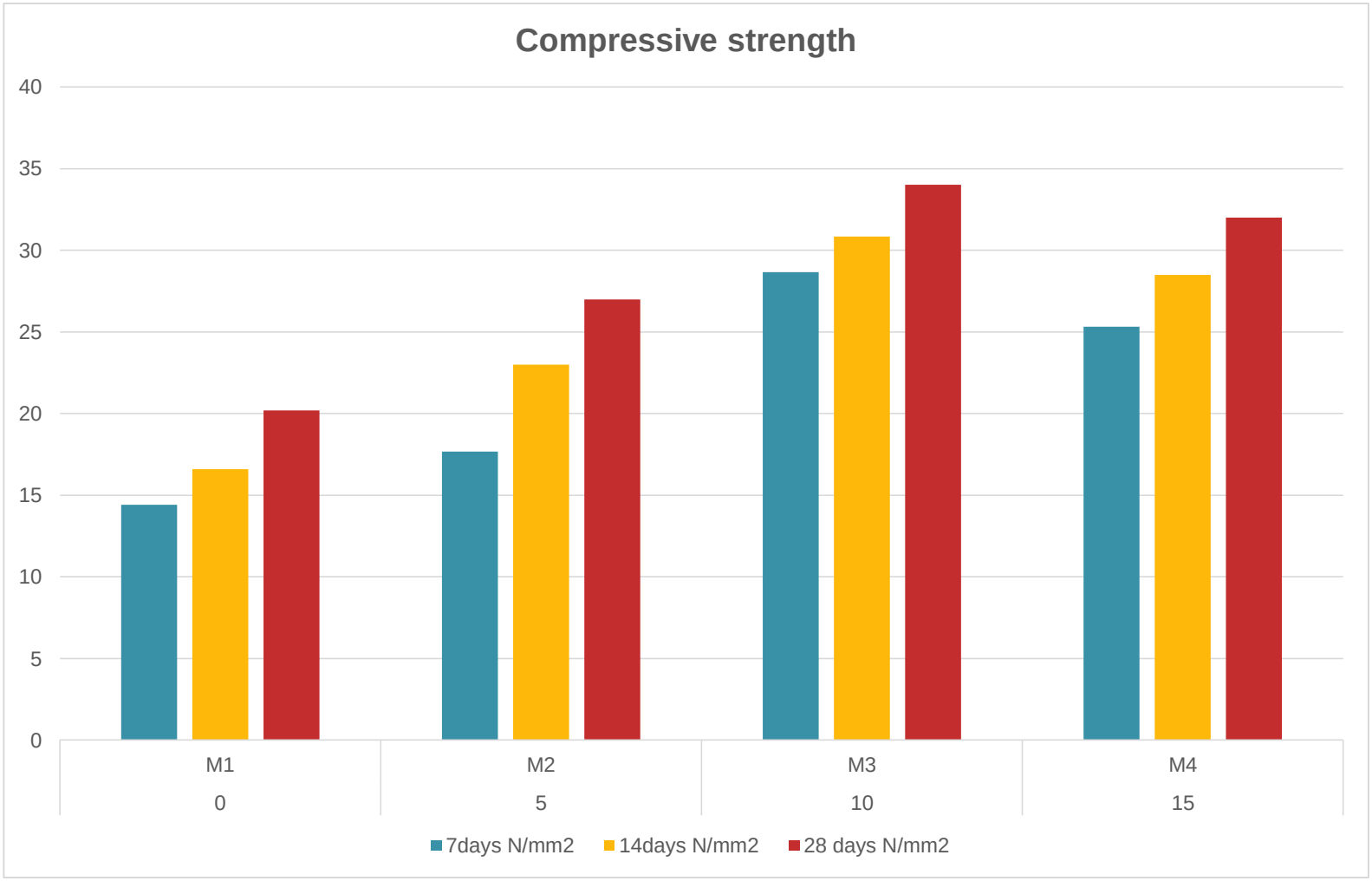
COMPRESSIVE STRENGTH RESULTS:

MK Content %	Mix	7 days N/mm2	14 days N/mm2	28 days N/mm2
0	M1	14.4	16.6	20.2
10	M2	16.57	22.29	26.45
20	M3	25.23	28.56	33.42
30	M4	26.25	29.33	35.23


Compressive strength
40
35
30
25
20
15
10
5
0
M1
0
M2
10
M3
20
M4
30
3 days N/mm2
7 days N/mm2
28 days N/mm2

compressive strength test result of alccofine.

ALC Content %	Mix	7days N/mm2	14days N/mm2	28 days N/mm2
0	M1	14.4	16.6	20.2
5	M2	17.66	23	27
10	M3	28.66	30.83	34
15	M4	25.33	28.5	32


Compressive strength
40
35
30
25
20
15
10
5
0
M1
0
M2
5
M3
10
M4
15
7days N/mm2
14days N/mm2
28 days N/mm2

Conclusion :

- Metakaolin reduces workability. However, in certain cases with appropriate doses of plasticizers the effective not much.
- The gain in compressive strength is improved depending upon the replacement level of OPC by metakaolin.
- Metakaolin inclusion generally improves tensile strength, flexural strength, bond strength and modulus of elasticity. The quantum of increase in the individual

- Increase strength
- Improved durability
- Reduces segregation
- Improved workability
- Better retention ofworkability

References

- 1.**Compressive Strength and Chloride Resistance of Metakaolin Concrete**
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- **2.Effects of Metakaolin and Silica Fume on Properties of Concrete by Jian-Tong Ding and Zongjin Li**

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- 4.**Strength and Durability Properties of High Performance Concrete incorporating High Reactivity Metakaolin .B. B. Patil1, P. D. Kumbhar**

THANKS