Establishment of Sustainable Concrete by Effective Replacement of Cement with Ceramic Waste

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Abstract

Ceramic waste is one of the most pronound research areas that include many area of engineering. Ceramic waste act as pollutants. It is producing dust which is harmful for public health as well as agricultural growth. Utilization of ceramic waste is the best way to protect the environment and also improve the quality of product where it will use industries like construction agriculture, paper, and glass are the best utilizer of ceramic waste. In construction industries ceramic waste can be used to produce ecofriendly concrete. In this project work ordinary Portland cement has been replaced by ceramic waste powder accordingly in the range of 0%, 15%,25%,35%,45% and 55 % by weight of cement in M : 25 and M:40 grade of concrete. Concrete were produced and tested with different proportion of ceramic waste and with super plasticizer for M:40 and result were compared. These test were carried out for 7 days, 14 days and 28 days. Result was an increase in strength in properties of concrete up to replacement of 25% and 15 % for M: 25 and M: 40 respectively. This project work related to experimental investigation to evaluate the characteristics compressive strength of concrete and optimum proportion of replacement ceramic waste. The aim of this project is to establish the sustainable concrete by effective replacement of cement with ceramic waste.
Keywords: Ceramic Waste, M:25 ,M:15, Characteristics Compressive Strength

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I. Introduction

Compressive strength is the most important property of hardened concrete and workability, bleeding and segregation is the property of green concrete Ceramic waste may mix in concrete in many forms such as fine aggregate, coarse aggregate or may replace with cement as binding material. Ceramic waste may come from two sources. The first source in India is the ceramics industry, and this waste is classified as non-hazardous industrial waste (NHIW). According to the Integrated National Plan on Waste 2008-2015, NHIW is all waste generated by industrial activity which is not classified as hazardous in Order MAM/304/2002, of the 8th February, in accordance with the European List of Waste (ELW) and identified according to the following sources : Waste from thermal processes. , Waste from the manufacture of ceramic products, bricks, roof tiles and construction materials. ,Ceramic, brick, roof tile and construction materials waste (fired)The second source of ceramic waste is associated with construction and demolition activity, and constitutes a significant fraction of construction and demolition waste (CDW), as will be addressed in more detail below Ceramic waste may come from two sources. The first source in India is the ceramics industry, and this waste is classified as non-hazardous industrial waste (NHIW). According to the Integrated National Plan on Waste 2008-2015, NHIW is all waste generated by industrial activity which is not classified as hazardous in Order MAM/304/2002, of the 8th February, in accordance with the European List of Waste (ELW) and identified according to the following sources : Waste from thermal processes, Waste from the manufacture of ceramic products, bricks, roof tiles and construction materials, Ceramic, brick, roof tile and construction materials waste (fired) The second source of ceramic waste is associated with construction and demolition activity, and constitutes a significant fraction of construction and demolition waste (CDW), as will be addressed in more detail below. This kind of waste is classified by the ELW according to the following sources: Construction and demolition waste, Concrete, bricks, roof tiles and ceramic materials, Roof tiles and ceramic materials The development concrete structure and technology at very rapid rate and it cannot be replaces with any other element of same properties. It is very essential to adopt some new technology so as to modify and enhance the properties of concrete and reduces the use of ingredients of concrete like cement, sand, aggregate to makes it economical and eco- friendly. There is also a wide opening of different experiments with concrete which can be withstood with the requirement of new growing world in which Ordinary concrete may fails to fulfill the durability and performance requirements. In such cases it is very essential to make changes in old pattern.

Admixture is the face of that change requires achieving the target. Admixture and pozzolonic material can modify the properties of ordinary concrete with different aspect so as to make it suitable for different situations.
Ceramic waste is one of those pozzolonic materials.

II. LITRETURE REVIEW

Establishment of sustainable concrete by effective replacement of cement with ceramic waste is one of the demanding researches topic in these days to compete with the requirement of modernization. Many research have been done with different method and gives different results whicAmitkumar D. Raval, Indrajit N. Patel, JayeshkumarPitroda Use of Ceramic Powder as a Partial Replacement of Cement the OPC cement has been replaced by ceramic waste powder accordingly in the range of 0%, 10%, 20%, 30% 40%, & 50% by weight for M-25 grade concreteh were helpful to complete this project. D. Tavakolia, A. Heidari*, b and M. Karimianb Using ceramic wastage in concrete production causes no remarkable negative effect in the properties of concrete.and many other concluded different conclusion some of them are Siva NageswaraRao (1996),R. Malathy, Kongu Engineering College, India K. Subramanian Khalid Najim, Ibrahim Al-Jumaily, AbdukhaliqAtea (Elsevier-2015)

A. *Object*

- To find the optimum proportion of ceramic waste with respect to strength and workability.
- To achieve the production of economical concrete by use of ceramic waste.
- To know the feasibility of utilization and disposal of ceramic waste

III. METHODOLOGY

Table – 1
Material used

SL. NO.	*Name of the Material*	*Sources of Material*
1	*Cement*	*PSC manufactured by ACC*
2	*Sand (Fine Aggregate)*	*Procured From Local Supplier*
3	*Coarse aggregate*	*Procured From Local Supplier*
4	*Ceramic waste as Admixture*	*Procured From*
5	*Water*	*Civil engineering Lab*
6	*Super plasticizer*	*Conaplast Sp430*

B. *Chemical Constituents of Ceramic Waste*

Material	*Ceramic powder (%)*
Sio_2	63.28
Al_2o_3	18.22
Fe_2o_3	4.53
Cao	4.46
Mgo	0.78
P_2o_5	0.16
K_2o	2.18
Na_2o	0.75
So_3	0.11
cl^-	0.005
Tio_2	0.62
Sro_2	0.02
Mno_3	0.05

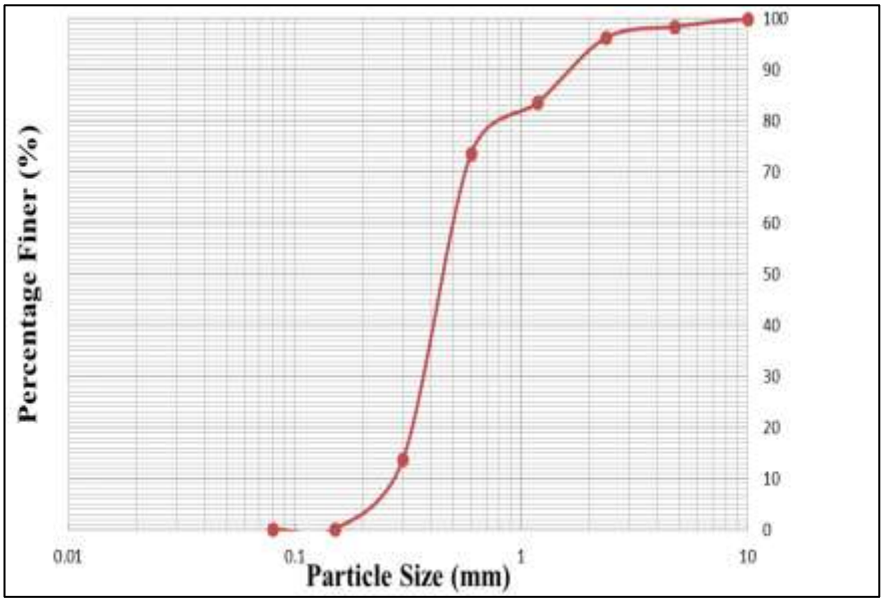

Fig. 1: particle size distribution of fine aggregate

Table - 3
Ingredients of M:25 concrete

Material	*Normal concrete*	*15% ceramic waste*	*25% ceramic waste*	*35% ceramic waste*	*45% ceramic waste*	*55% ceramic waste*
Cement	*458.13*	*389.41*	*343.59*	*297.78*	*251.97*	*206.15*
Ceramic powder	*0*	*43.2*	*72*	*100.8*	*129.6*	*158.4*
Fine aggregate	*606*	*385.92*	*385.92*	*385.92*	*385.92*	*385.92*
Coarse aggregate	*1118*	*797.76*	*797.76*	*797.76*	*797.76*	*797.76*

Table- 4
Ingredients of M:40 concrete

Material	*Normal concrete*	*15% ceramic waste*	*25% ceramic waste*	*35% ceramic waste*	*55% ceramic waste*	*15% ceramic waste*
Cement	*346*	*294.1*	*259.5*	*224.91*	*190.3*	*155.7*
Ceramic powder	*0*	*51.9*	*86.5*	*121.1*	*155.7*	*190.3*
Fine aggregate	*669*	*669*	*669*	*669*	*669*	*669*
Coarse aggregate	*1262*	*1262*	*1262*	*1262*	*1262*	*1262*
Spconaplast	*0.69*	*0.69*	*0.69*	*0.69*	*0.69*	*0.69*

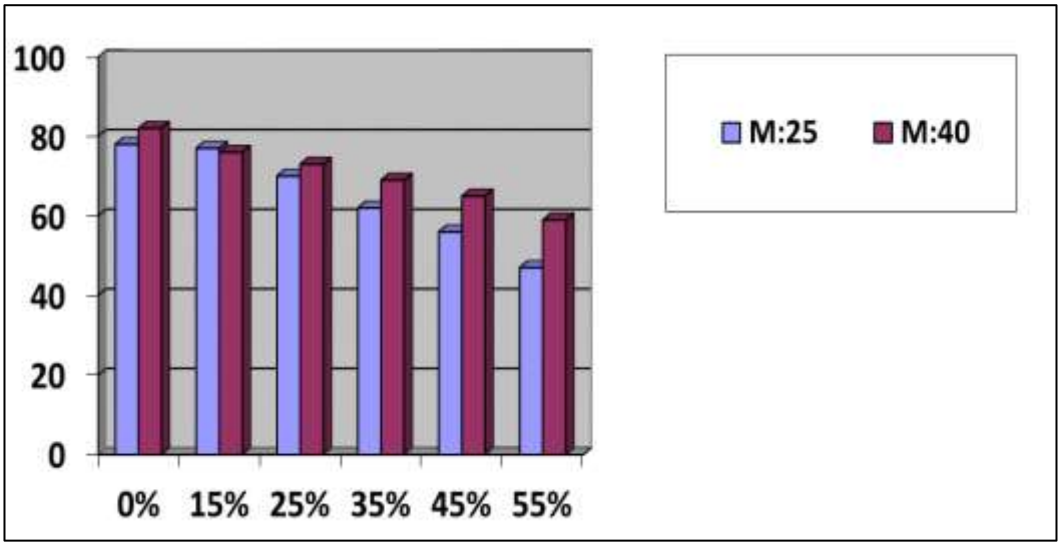

Fig. 2: slump value of concrete

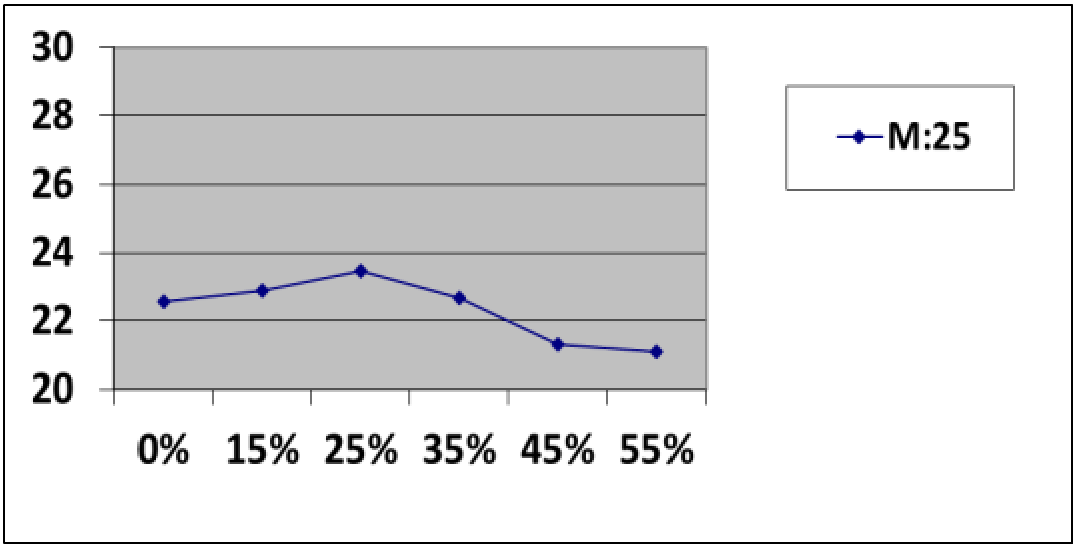

Fig. 3: Compressive strength of M: 25 concrete at 7 days

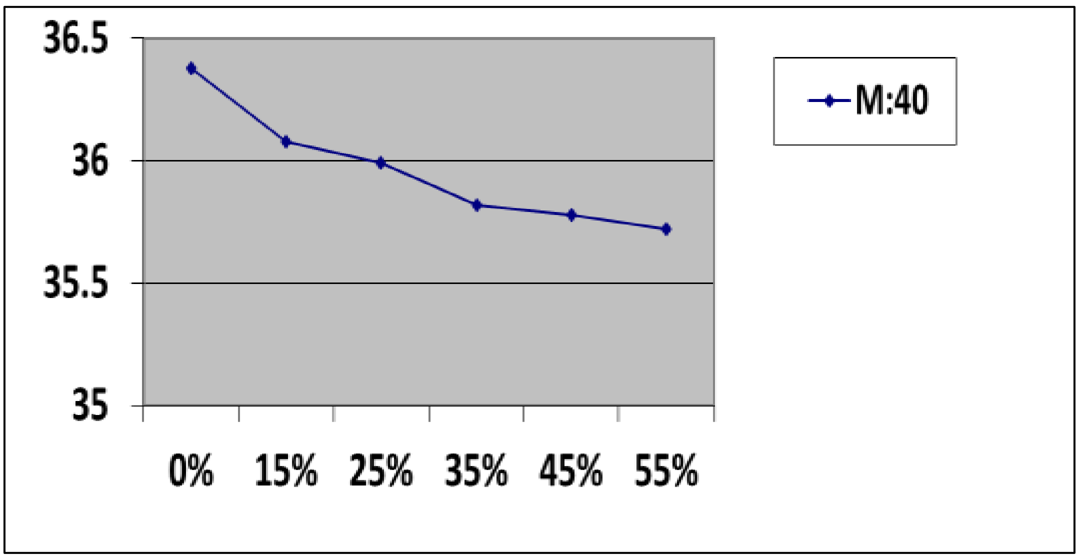

Fig. 4: Compressive strength of M: 40 concrete at 7 days

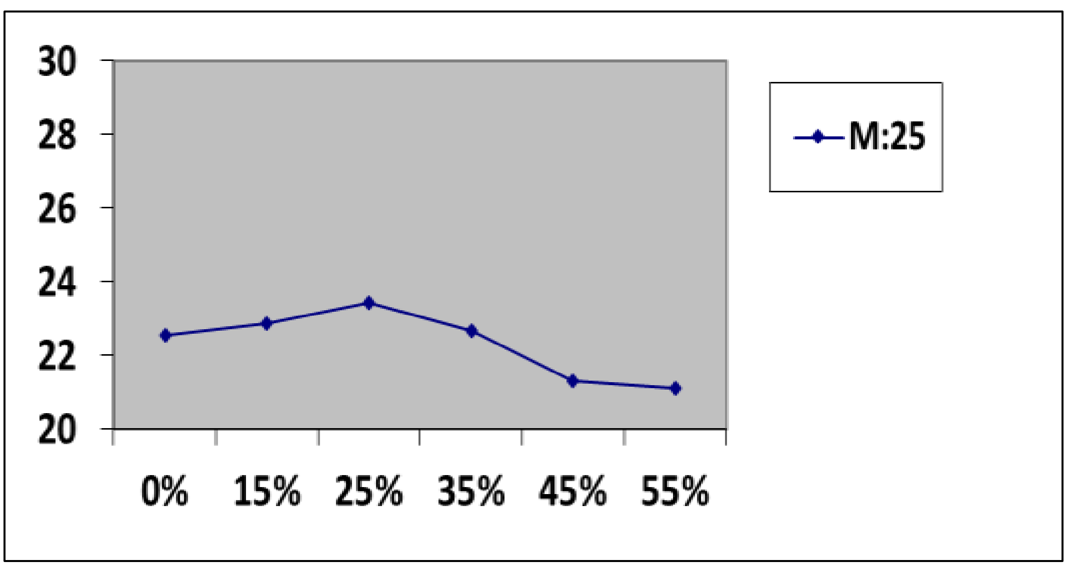

Fig. 5: compressive strength of M: 25 concrete at 14 day

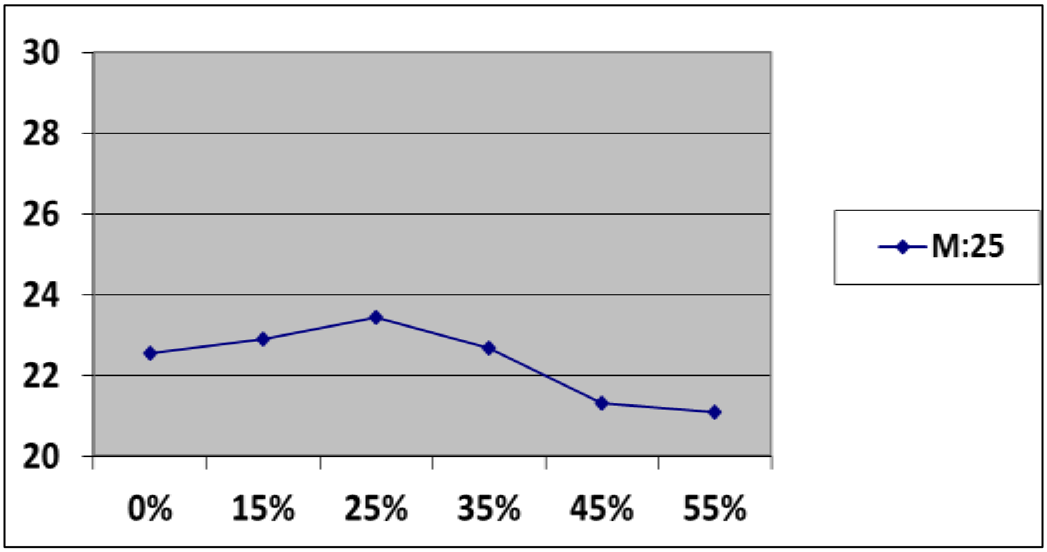

Fig. 6: compressive strength of M: 40 concrete at 14 days.

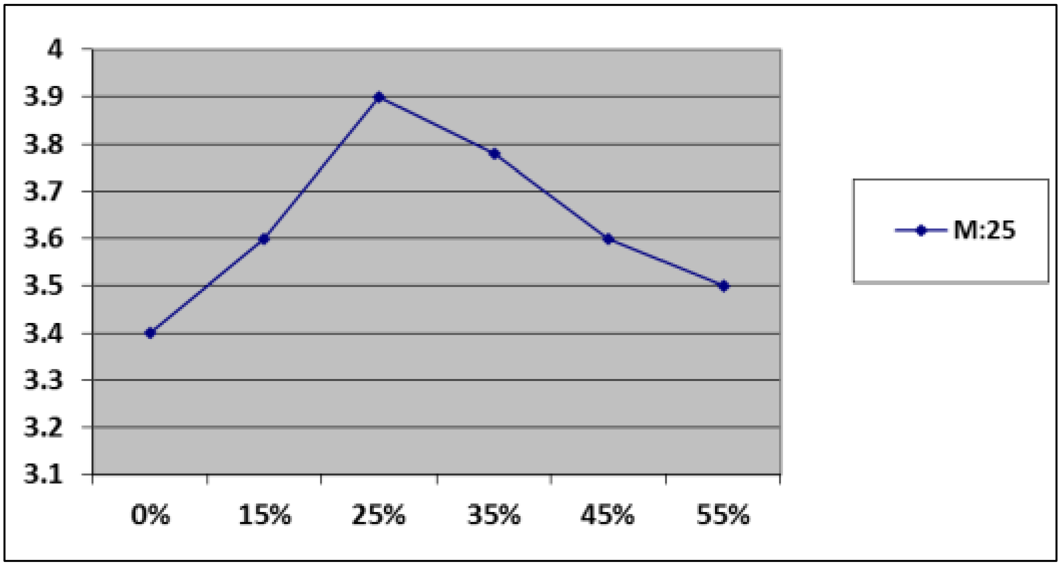

Fig. 7: compressive strength of M: 25 concrete at 28 days

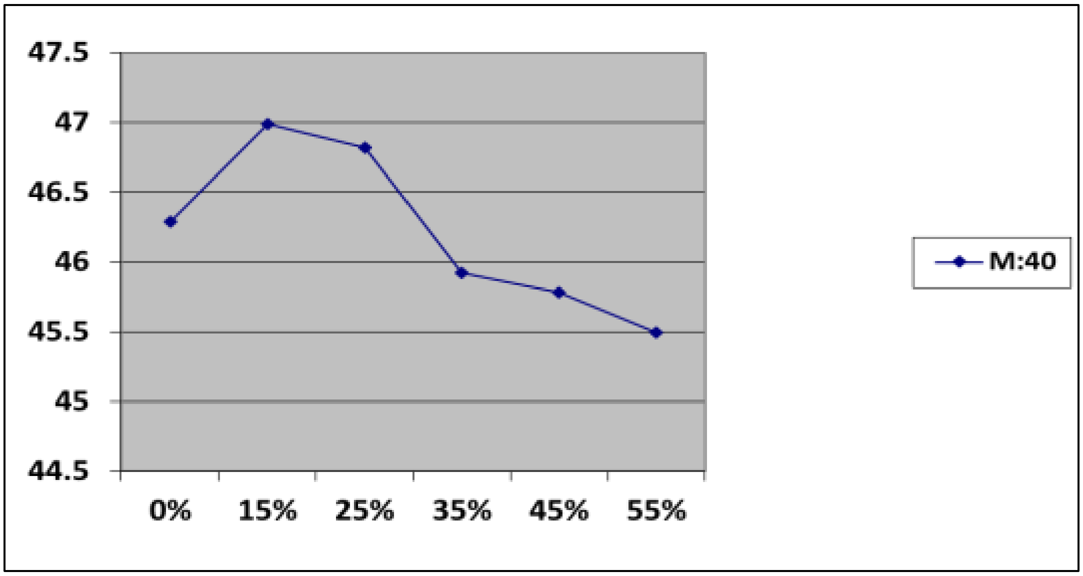

Fig. 8: compressive strength of M: 40 concrete at 28 days

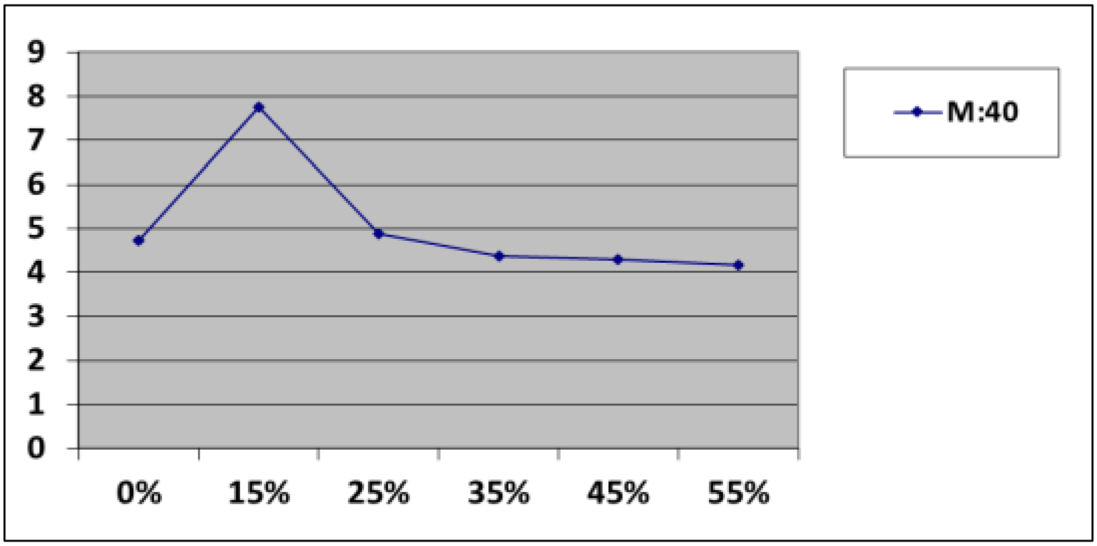

Fig. 9: flexure strength of concrete after 28 days

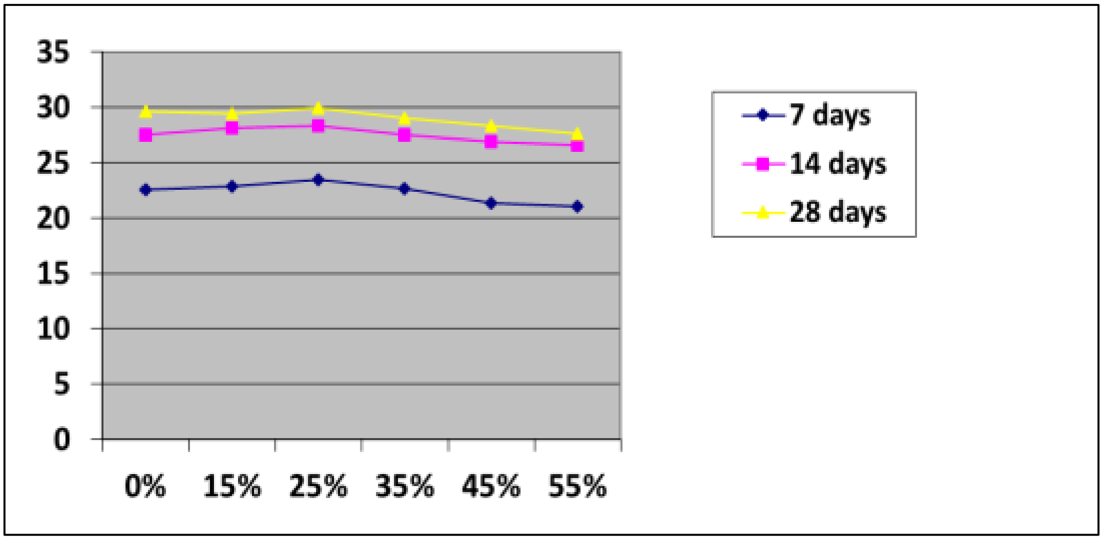

Fig. 10: compressive strength of M: 25 concrete at 7 ,14 and 28 days.

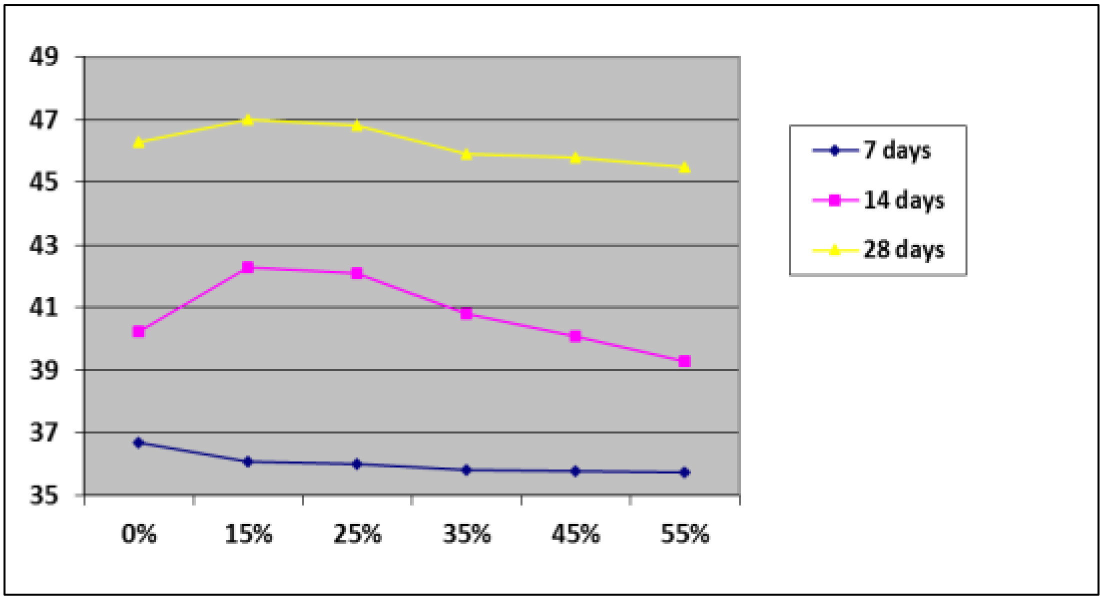

Fig. 11: compressive strength of M: 40 concrete at 7, 14 and 28 days.

IV. RESULT

1) According to these results Super Plasticizers, for high-strength concretes by decreasing the w/c ratio as a result of reducing the water content by 20–30%.
2) By adding of ceramic waste at 0, 15, 25, 35, 45 and 55% at 25% gives optimal result for M:25 and 15% for M:40 grades at 14 and 28 days strength and increases strength up to 25% and 15% respectively after that further gives addition decreases in strength
3) The slump value is decreases by adding increase percentage of ceramic waste
4) For 7 days strength it shows that strength is decreasing

V. FURTHER SCOPE

In present years there is rapid change in the development on concrete like high-performance concrete (HPC) and High Strength Concrete (HSC), compacted reinforced concrete (CRC), reactive powder concrete (RPC) etc.
The further scope of this work can be summarized as follows:
1) Ceramic waste is also available in aggregate form so replacement can be done with sand and aggregate.
2) For better result different percentage of plasticizers should be taken to reduce the amount of water
3) Durability can be check by different curing methods.
4) Modulus of elasticity and split tensile strength of HSC should be investigated also.

REFERENCES

[1] Sustainable Development: An Introduction, Internship Series, Volume-I, Centre for Environment Education, 2007 "STRATEGYFOR SUSTAINABLE CONSTRUCTION" HM Government,JUNE 2008
[2] K. S. Al-Jabri, A. W. Hago, R. Taha, A. S. Alnuaimi and A. H. Al-Saidy "Strength and Insulating Properties of Building Blocks Made from Waste Materials", Journal of Materials in Civil Engineering, 2009, Vol.21, No. 5,page no: 191–197
Fernando and Said "Compressive strength and durability properties of ceramic wastes based concrete", Materials and Structures, 2009, vol. 44,page no:155–167
[3] K.Abdullah, M.W.Hussin, F.Zakaria ,R.Muhamad, Z.Abdul Hamid "POFA : A Potential Partial Cement Replacement Material in Aerated Concrete", Proceedings of the 6th AsiaPacific Structural Engineering And Construction Conference, (APSEC 2006), 2006
[4] WeerachartTangchirapat, TirasitSaeting, Chai Jaturapitakkul, KraiwoodKiattikomol, AnekSiripanichgorn "Use of waste ash from palm oil industry in concrete", Waste Management, 2007, vol.27, page no: 81–88.
[5] YadavIshwar Singh, Maneek Kumar and ShwetaGoyal, "Laboratory Investigations Of The Properties Of Concrete containing Recycled Plastic Aggregates", M.Tech Thesis, Thapar University, 2008.
[6] Ponnapati. Manogna1, M. Sri Lakshmi (July-2015) Tile Powder As Partial Replacement Of Cement In Concrete.
[7] Dr. B. Krishna Rao*, Manthena.Sri Lakshmi (2013) Use of Tile Dust as Partial Replacement for Cement in Concrete.
[8] Amitkumar D. Raval1, Dr.Indrajit N. Patel, Prof. JayeshkumarPitroda(2013) Ceramic Waste : Effective Replacement Of Cement For EstablishingSustainable Concrete.
[9] Naveen Kumar MS1, Nikhil B2, Nikhil Patel AR3, Nagaraja R4 and Veena Kumara Adi(2016) Experimental studies on clay tile powder as partial replacement of cement for sustainable concrete
[10] IS: 383-1970, Specification for Coarse and Fine Aggregates from Natural Sources for Concrete, Bureau of Indian standards, New Delhi, India.
[11] IS:1727-1967, Methods of Test for Pozzolonic Materials, Bureau of Indian standards, New Delhi, India
[12] IS:4031(Part-4)-1995, Methods of Physical Tests for Hydraulic Cement-Determination of Consistency of Standard Cement Paste, Bureau of Indian standards, New Delhi, India
[13] IS:4031(Part-5)-1988, Methods of Physical Tests for Hydraulic Cement-Determination of Initial and Final Setting Times, Bureau of Indian standards, New Delhi, India.
[14] IS:4031(Part-6)-1988, Methods of Physical Tests for Hydraulic Cement - Determination of Compressive Strength of Hydraulic Cement other than Masonry Cement, Bureau of Indian standards, New Delhi, India.