

**International Journal of Innovative Research in Science,  
Engineering and Technology**

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 5, May 2017

# **Experimental Study on the Mechanical Properties of Self Curing Concrete with Liquid Paraffin Wax and Super Absorbent Polymer**

Clista Babu<sup>1</sup>, Arsha S<sup>2</sup>

P.G. Student, Department of Civil Engineering, Indira Gandhi Institute of Engineering & Technology for Women

Kothamangalam, Kerala, India<sup>1</sup>

Assistant Professor, Department of Civil Engineering, Indira Gandhi Institute of Engineering & Technology for

Women Kothamangalam, Kerala, India<sup>2</sup>

**ABSTRACT:** As water is becoming a scarce material day-by-day, there is an urgent need to do research work pertaining to saving of water in making concrete and in constructions. Curing of concrete is maintaining satisfactory moisture content in concrete during its early stages in order to develop the desired properties. However, good curing is not always practical in many cases. Curing of concrete plays a major role in developing the concrete microstructure and pore structure and hence improves its durability and performance. Keeping importance to this, an attempt has been made to develop self-curing concrete by using water-soluble Super absorbent polymer (SAP) in order to supply an internal source of water and water-soluble liquid paraffin wax which reduces water evaporation from the surface of concrete and also helps in water retention.

**KEYWORD<sup>s</sup>:** SAP- Super absorbent polymer, LPW- Liquid paraffin wax.

## **I. INTRODUCTION**

Water is most commonly and frequently used raw material in construction field for aspects such as mixing and curing. This natural resource is also one of the important commodities used in many industries as well as in day to day needs in human life. As a result of this, water is about to become scarce. If this situation prevails, then the cost construction will reach to a point where common man cannot afford to build a home. Hence to mitigate this water problem in construction field, self curing concrete came into existence. Curing of concrete plays major role in developing the strength and hardness of concrete, which leads to its improvement in durability and performance. Practically good curing not at all achievable in many countries in many cases due to practical difficulties. In order to minimize this problem, many researchers conducted several studies to identify the self curing agent.

In order to achieve the designated self-curing concrete properties, water evaporation at the surface should be avoided in addition to supplying water from the exterior. If enough water is at the disposal of the cement paste for hydration to proceed, the concrete will achieve excellent properties. The traditional ways of curing often fail in practice. Even when meticulously performed only water evaporation can be reduced, but the water supply on the surface of vertical structural elements is still a technical problem. In the case of high strength concrete (HSC) used commonly for vertical structural elements the problem is more difficult. The very dense structure of high-performance concrete might lead to the assumption that water evaporation is low and therefore water from the surrounding can penetrate only very slowly and not in a sufficient amount to reach the interior of the member. So, the effect of curing can therefore be neglected. Saving the curing time would positively influence the construction costs. On the other hand when exposed to air, water

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 5, May 2017

evaporation was observed resulting in a considerable reduction of the compressive strength and micro cracks appear. Many researches showed failure of the traditional curing methods for HSC. Currently, there are two major methods available for internal curing. The first method uses Super absorbent polymer (SAP) in order to supply an internal source of water and the second one uses liquid paraffin wax which reduces water evaporation from the surface of concrete and also helps in water retention.

## II. RELATED WORK

Large number of investigators conducted different experimental studies on concrete to explore a new technology called self curing concrete. It is a novel technology which considerably reduce the water usage for curing of concrete structures. The main point which are concluded from previous work are given below.

- Self curing of concrete helps to Maintain saturation of the cement paste during hydration, avoiding self-desiccation in the paste and reducing autogenous shrinkage.
- Lower dosage liquid paraffin wax compounds act as the best curing compound in higher grade concrete.
- The use of lower dosage of SAP improves the mechanical properties of concrete.

## III. SCOPE

The main objectives of this project work are listed as follows

- ✓ To evaluate the effect of different types of self-curing agent, ie Liquid Paraffin wax and SAP on the mechanical properties of concrete such as,
  - Compressive strength
  - Tensile strength
  - Flexural strength.
- ✓ To evaluate the optimum percentage of self-curing agent on the mechanical properties of concrete.

## IV. EXPERIMENTAL WORK

The experimental program was conducted to investigate the strength of self curing concrete by adding 0.2%, 0.4% and 0.6% by weight of cement of SAP and 0.1%, 0.5% and 1.0% by weight cement of LPW. The specimens were prepared for control mix and replaced mixes to determine hardened properties of concrete such as cube compressive strength, split tensile strength and flexural strength. The specimens were maintained at ambient temperature for 24 hours within the moulds, then demoulded and air cured for 28 days. Various mechanical properties such as compressive strength, split tensile strength and flexural strength of different specimens are to be evaluated.

## V. MATERIALS USED

- **Cement**  
The cement used is Siddhi, Ordinary Portland Cement (OPC) of 53 grade, conforming to IS 4031, IS 269 and IS 12269.
- **Fine Aggregate**  
Fine aggregate used for this is M-sand. Laboratory test was conducted on fine aggregates to determine the different physical properties. The aggregate conforms to zone II of IS 383-1970 (Reaffirmed 2002).
- **Coarse Aggregate**  
The coarse aggregate used was 20 mm. Laboratory tests were conducted on coarse aggregate to determine the different physical properties as per IS 383-1970.

## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 5, May 2017

### ➤ Super Absorbent Polymer

Super absorbent polymer (SAP) are polymeric materials that have the ability to absorb a large amount of liquid from the surroundings and retain it within their structure. SAPs are mainly developed for absorption of aqueous solutions and, in extreme cases, they may have a water uptake of 5000 times their own weight. Fig.1 shows the SAP which is used in the study. Standard, industrial-quality SAPs typically have a water absorption of 100 to 400 g/g dry, and they can be produced in almost any size and shape. Pre wetted SAP were used in this experimental work.



Fig 1: Super absorbent polymer

### ➤ Liquid Paraffin Wax

Water soluble polymers are likely to reduce the water evaporation from the concrete and there by increases the water retention capacity of the concrete. Fig.2 shows the Liquid paraffin wax which is used in the study. The chemical were mixed with water thoroughly before mixing the water into the concrete.



Fig 2 : Liquid paraffin wax

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 5, May 2017

## VI. AIR CURING OF SPECIMENS

The specimens which are casted in different mix proportions are demoulded after 24 hours. Normally the demoulded specimens are kept under water for 7 and 28 days and measure its strength. In this project work the control specimen is kept under water and all other mixes are kept in open air for specified time period which is shown in fig.3. During this period no water is added to the specimens and the water normally required for curing of concrete blocks are taken from the self curing agents which are added with each mix.



Fig 3 : Air curing of specimens

## VII. EXPERIMENTAL RESULTS

In this project the possibility of replacing conventional curing with the air curing is examined. The self curing agents like super absorbent polymer and liquid paraffin wax are used for this study. And its effects on the mechanical properties of concrete is also studied. In this work SAP and LPW is added in to the designed mix, like an admixture. The results for the compressive strength, split tensile strength and flexural strength are shown below.

### ➤ Compressive Strength

The variation of compressive strength with different percentage of SAP and LPW is shown in table 1 and its graphical representation is in figure 4. for 28<sup>th</sup> day. From the result it is observed that the compressive strength of air cured concrete is increases with LPW up to 0.5% then it is decreases for 1.0% of LPW with every combination of SAP. The mix  $M_8$  with 0.6 % SAP and 0.5 % LPW give max compressive strength as compared to all other mixes. There is observed an increase of 23.05 % of compressive strength for mix  $M_8$  as compared to conventional concrete.

## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 5, May 2017

Table 1: Variation of Compressive strength.

SAP/LPW	0.1 %		0.5 %		1.0 %	
	7 <sup>th</sup> day	28 <sup>th</sup> day	7 <sup>th</sup> day	28 <sup>th</sup> day	7 <sup>th</sup> day	28 <sup>th</sup> day
0.2 %	34.07	42.89	30.19	45.17	33.07	41.85
0.4 %	39.15	44.15	37.92	47.11	34.21	40.89
0.6 %	40.59	40.50	42.76	52.22	33.79	40.10

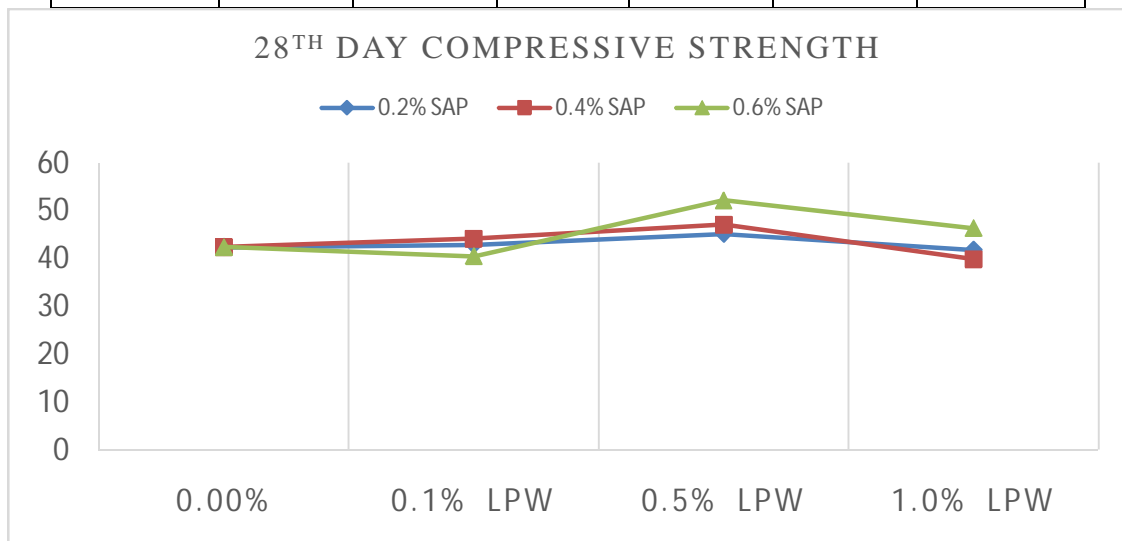


Figure 4 : Variation of 28<sup>th</sup> day Compressive strength.

### ➤ Split Tensile Strength

The results of variation of split tensile strength for various percentage of SAP and LPW are shown in table 2. and its graphical is shown in figure 5. for 28<sup>th</sup> day. It is observed that concrete with 0.6 % SAP and 0.5% LPW give better tensile strength as compared to other mixes. 5.6 % increase is observed in split tensile value as compared to conventional concrete. In the case of 1.0 % of LPW 10.5% of decrease in split tensile strength is observed.

Table 2 : Variation of Split tensile strength.

SAP/LPW	0.1 %		0.5 %		1.0 %	
	7 <sup>th</sup> day	28 <sup>th</sup> day	7 <sup>th</sup> day	28 <sup>th</sup> day	7 <sup>th</sup> day	28 <sup>th</sup> day
0.2 %	4.78	5.38	4.84	5.29	4.91	5.19
0.4 %	5.01	5.34	5.19	5.42	4.63	5.08
0.6 %	4.90	5.38	5.22	5.65	4.75	5.06

## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 5, May 2017

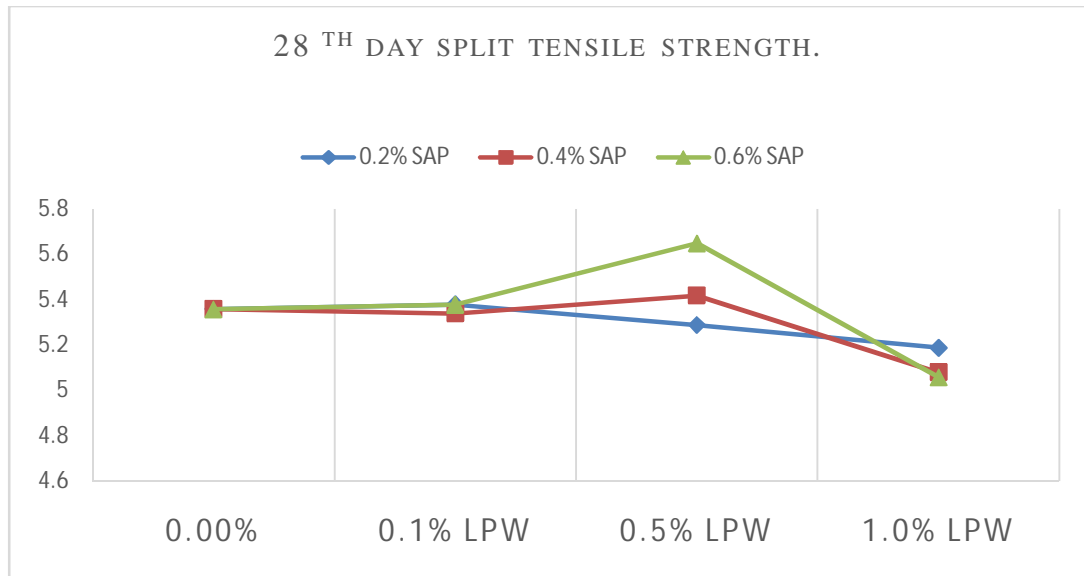


Figure 5: Variation of 28<sup>th</sup> day Split tensile strength.

### ➤ Flexural Strength

The flexural test were carried out for various percentage of SAP and LPW. The test results are shown in table Table2 and its graphical is shown in figure 6.for28<sup>th</sup> day. It is observed that flexural strength of all mixes with self curing agent gives comparatively lower value than conventional concrete. Minimum value of 25.84 % decrease is observed for 0.4 % SAP and 0.5% LPW.

Table 2 Variation of Flexural strength.

SAP/LPW	0.1 %		0.5 %		1.0 %	
	7 <sup>th</sup> day	28 <sup>th</sup> day	7 <sup>th</sup> day	28 <sup>th</sup> day	7 <sup>th</sup> day	28 <sup>th</sup> day
0.2 %	3.47	3.38	2.53	3.63	4.91	4.13
0.4 %	5.01	3.62	5.19	4.88	3.50	4.05
0.6 %	3.25	4.05	4.75	4.30	3.50	4.56

## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 5, May 2017

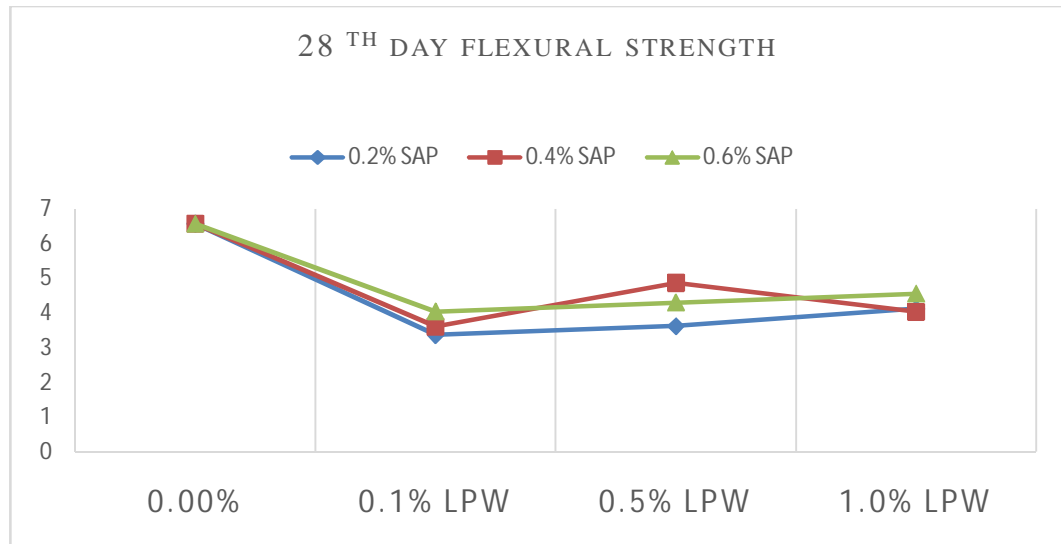


Figure6 : Variation of 28<sup>th</sup> day flexural strength.

### VIII. CONCLUSION

During this project work the effects self curing agents like super absorbent polymer and liquid paraffin wax on the mechanical properties of concrete were studied. M-30 mix is used and it is designed according to IS 10262 : 2009. The concrete specimens such as cubes, cylinders and beams are to be casted and tested for finding the strength of concrete for various percentage replacement of cement with SAP and LPW. Based on the investigation following conclusions is drawn.

- The mix contain 0.6 % SAP and 0.5 % LPW as percentage replacement of cement gives maximum compressive strength. An increase of 25.03% compressive strength is achieved with the above mix.
- For every combination of SAP ( 0.2% , 0.4%, 0.6% ) maximum strength is obtained with 0.5% of LPW.
- As the percentage replacement of LPW increases the strength will decreases.
- The split tensile strength is increased by 5.6 % for 0.6 % SAP and 0.5% LPW.
- The flexural strength of air cured mixes is decreased by a minimum value of 25.84% as compared to conventional concrete

### REFERENCES

- [1] Magda I. Mousa , Mohamed G. Mahdy , Ahmed H. Abdel-Reheem ,Akram Z. Yehia : "Mechanical properties of self-curing concrete" HBRC Journal,vol. 11, pp.311–320,2015.
- [2] Magda I. Mousa , Mohamed G. Mahdy , Ahmed H. Abdel-Reheem ,Akram Z. Yehia : "Self-curing concrete types; water retention and durability" Alexandria Engineering Journal,vol. 54, pp.565–575,2015.
- [3] M.Pavan Kumar, SunkaraPavanAyyappa, G.T.Naidu : "An experimental study on self curing concrete using liquid paraffin wax"International Journal of Research in Engineering and Technology ,vol.12,pp.125-131,2016.
- [4] P Swamy Naga RatnaGiri, Madduru Sri Rama Chand, Garje Rajesh Kumar, PancharathiRathish Kumar : "Paraffin wax as an internal curing agent in ordinary concrete" Magazine of Concrete Research ,vol.9,pp.12-19,2014.
- [5] Fazhou Wang, Yufei Zhou, Bo Peng, Zhichao Liu, and ShuguangHu : "Autogenous Shrinkage of Concrete with Super-Absorbent Polymer"ACI Materials Journal,vol45,,pp.123-127,2009.
- [6] Madduru Sri Rama Chand, Pancharathi,PallapothuSwamy Rajesh Kumar, Mupparisetty V. Krishna Rao : "Influence of paraffin wax as a self-curing compound in self-compacting concretes" Advances in Cement Research,vol.28, pp.110-120,2015.
- [7] GopiRajamanickam, Revathi V: "Self compactingself curing concrete with lightweight aggregates"Gradevinar,vol.3pp.279-285,2016.
- [8] Kenneth Sequeira, Raghu H. Naik, B. H. V. Pai,:"Use of superabsorbent polymers in internally cured concrete- a review"International Research Journal of Engineering and Technology vol.2,pp.1593-1595,2015.
- [9] Patel ManishkumarDahyabhai, Jayeshkumar R. Pitroda : "Introducing the Self-Curing Concrete in Construction Industry"International Journal of Engineering Research & Technology vol. 3, pp.1286-1289,2014.