FLEXURAL BEHAVIOR OF REINFORCED CONCRETE BEAMS USING SUPER ABSORBENT POLYMER AS INTERNAL CURING

By

Baidaa Khdheer Ahmed

Supervisor by

Asst. Prof. Dr. Suhad Mohammed Abd

ABSTRACT

The problems associated with increasing strength of concrete are the focus of a wide area of research. High and ultra-high strength concrete tends to develop early cracking. The lower the w/b the earlier and greater the development of autogenous shrinkage which increases with increasing compressive strength. This leads to internal cracking and weakening the performance of concrete. Providing the means of internal curing to solve the problem of autogenous shrinkage related to high and ultra- high strength concrete is limited to light weight aggregate LWA. Recently, the Super Absorbent Polymer SAP, which is considered to be smart materials that can hold and absorb water effectively and release it when needed in dry conditions, has been used for this purpose.

This study comprises two stages. The first stage includes the production of five concrete mixes with different strength levels (normal, high, very high and ultra-high strength). These are: reactive powder concrete RPC, modified reactive powder concrete MRPC, high strength concrete HSC, self- compact concrete SCC and normal strength concrete NSC. The properties of concrete in the fresh and hardened state are studied for the five concrete mixes with and without SAP addition. These properties include: workability for fresh concrete, compressive strength, (splitting and flexural) tensile strength, modulus of elasticity, autogenous and drying shrinkage. The second stage

covers the effect of SAP addition on flexure behaviour of the reinforced concrete beam. Ten beams are casted, five for concrete mixes without SAP and the other five beams with SAP addition. Load carrying capacity, deflection and crack width has been investigated.

The results collected from the first stage reveal that the addition of SAP increases workability for mixes due to increased quantity of water in the mix. Addition of SAP reduces strength of concrete in term of compressive, splitting, flexural as well as modulus of elasticity up to 28 days. After 28 days, clear improve in compressive strength was recorded which belong to continuous hydration process due to availability of water from internal curing (with the addition of SAP) which promotes continuous development in compressive strength clearly at the age of 56 days. It is expected to gain more strength at ages after 56 days. SAP addition is found to reduce autogenous and drying shrinkage remarkably; for autogenous shrinkage the reduction is (64%, 46%, 42%, 62%, and 54%) and drying shrinkage reduction was (89.5%, 72%, 82%, 70% and 71%) for RPC, MRPC, HSC, SCC and NSC respectively. Results of the second stage reveal that the addition of SAP increases load carrying capacity for reinforced concrete beams of all types of concrete. Moreover, the deflection of the reinforced concrete beams containing SAP is reduced compared with reinforced concrete beams without SAP. The reduction in deflection is (9.4%, 8%, 20%, 23% and 12%) for RPC, MRPC, HSC, SCC and NSC respectively. The same results are attained for crack width which is improved due to SAP addition, the reduction is (12.5%, 11.8%, 13.7%, 13.3%, and 20%) for RPC, MRPC, HSC, SCC and NSC beams respectively. It can be concluded that it is possible to use SAP as internal curing agent in order to improve properties of concrete in general on the long term as it takes time in order to release water to maintain hydrations.