STUDY ON THE USE OF BETOCARB IN PORTLAND CEMENT CONCRETE PAVEMENT (PCCP)

The continued growth of the world construction sectors has resulted in high demand for concrete materials. The innovation of using filler as a replacement for cement is becoming a trend in order to reduce the cement consumption and provide benefit in various ways. In this study, 10% and 20% of cement was replaced by the calcium carbonate ($CaCO_3$). $CaCO_3$ is a natural material, which has a finer particles size as compared to the cement particles. This improves particle packing of concrete and give spacer effect. The concrete with $CaCO_3$ replacement possesses a higher slump, which increased the workability.

Research has been conducted in the laboratory. The $CaCO_3$ helps to increase the early strength, due to the accelerator effect and high rate of hydration which hardens the concrete quicker. At matured age, the concrete with the $CaCO_3$ addition exhibits lower strength as compared with concrete without $CaCO_3$, but still within the target strength. Two (2) pilot road research projects were conducted in Brgy. San Simon, Dinalupihan, Bataan and Norzagaray, Bulacan. The applied researches were conducted by partially replacing the cement in a Portland Cement Concrete Pavement (PCCP) and showed noticeable defects and observations and produced positive and acceptable results.

Calcium Carbonate is a common substance found in rock in all parts of the world, and is the main component of shells of marine organisms, snails, pearls, and eggshells. It is the active ingredient in agricultural lime, and is usually the principal cause of hard water. It is commonly used medicinally as a calcium supplement or as an antacid, but excessive consumption can be hazardous.

Omya, a global producer of industrial materials such as fillers, initially started to use calcium carbonate fine (CCF) as ingredients in paints but eventually incorporated CCF in concrete in the form of Betocarb. According to Omya, CCF accelerates the hydration of the cement matrix, resulting to higher early strength figures. Durability is also improved having high permeability characteristics. Based on their laboratory tests, the workability of semi-dry, plastic or self-compacting concrete and self-leveling mortars is improved. The particles size distribution in combination with cement and admixtures can be optimized, resulting to increased green strength and better pumping ability. For self-compacting concrete, CCF has proven to be the most reliable and practical industrially produced stabilizer. Strength – especially early strength – is obtained due to the catalytic crystallization of the CCF in combination with cement types such as Portland and blast furnace slag cements. The improved filling effect and particle size distribution of the cement results in a higher mechanical packing density. The adhesion of all ingredients is also improved. CCF is used in controllable low-strength and ultra-high performance concrete, as well as a vast range of mortars and screeds.

Betocarb is a micronized calcium carbonate which is physically and chemically active in cement mixtures. Also, it is a fine and consistent CCF from a physical and chemical point of view. The volume of fines can easily be adjusted and the density of formulations are optimized. It improves mechanical performance, the surface of formulated concrete and the productivity of industrial tools. Also, it is used in applications ranging from the very simple to more technical as outlined in the various formulations.

With the use of Betocarb, benefits are defined to optimize the water/cement ratio, improved processing, facing and binding, and better quality finished products.

The cost of the Betocarb is cheaper than the conventional concrete and the volume of cement to be incorporated will be reduced as well the cement factor due to the incorporation of the Betocarb. The cost will be cheaper by as much as 1.91% if 20% cement is replaced by Betocarb compare to the 1.08 % for concrete with 10% Betocarb replacement of cement.

According to the study, the $CaCO_3$ helps to increase the early strength, due to the accelerator effect and high rate of hydration which hardens the concrete quicker. This allowed the PCCP to be cured quicker than the conventional, thus, this enable the section to be immediately controlled the vibration of the road due to heavy vehicle passes on the side while curing. It can be concluded that the product showed positive evaluation.

It is noted that the Betocarb product is cheaper than the conventional. It is emphasized that cement factor may be less than the required 9.1, however, concrete strength has passed the required specifications.

It is therefore concluded that the Betocarb can be used in DPWH projects when aesthetics and early curing period are required. It is also concluded that the engineer shall do the mix design with care and consideration of cement factor, slump, and concrete cost.

It is recommended that Betocarb can be used as a partial replacement of cement with careful concrete mix design before use. The choice of 10% Betocarb is highly recommended compare to the 20% replacement to minimize the defects that can occur prematurely. This new technology will help the government to partially hasten the curing rate of the concrete structures that will also add aesthetics.

While the inspection and performance of the pilot projects show potential, further monitoring is still recommended before the approval of the technology be incorporated in governments projects. Furthermore, continuous monitoring is required to test if the new technology prolong the service life of the pavement.