STUDY ON THE
USE OF "WARM MIX ASPHALT (WMA) - ADVERA"

Traditionally, asphalt mixtures were produced and discharged at high temperatures (between 150°C to 180°C) and therefore often referred to as Hot Mix Asphalt (HMA), resulting in high energy (fuel) costs and production of greenhouse gases. As years pass by, the asphalt industry has initiated to increase energy savings and environmental benefits in cold or warm asphalt processes. Recently, a new technology named Warm Mix Asphalt (WMA) was developed in Europe that allows HMA to be produced at a lower temperature of 20 - 30°C lower, with no changes on mix design needed. Over years of research efforts, a few WMA technologies were introduced including the foaming method using Aspha-min® and Advera® WMA.

Advera Warm Mix Asphalt (WMA) is a synthetic mineral foaming additives for the manufacture of WMA. Since it is synthetic, it has standard size and moisture content. Advera WMA is an inorganic chemical in powder form containing 18 - 20% moisture at its equilibrium state which is chemically and structurally bound. Thus, it takes significant energy, temperatures above 100°C, to release this water. The release of moisture out of the sub-micron pore causes micro bubbles which gives long lasting workability and minimizes the amount of water which is lost to the bag house at the asphalt plant.

Plant and field personnel will not see any physical or operational difference in the performance or handling of the asphalt concrete. There will be a significant reduction in odor, heat and the blue smoke from the mix. The paving temperature, as well as the production temperature, will be 20 - 30°C cooler. Normal compaction patters should be utilized. Improved densities should be noted. During compaction, the steam that improved the workability of the asphalt concrete will be compressed out of the mix. Should any residual moisture remain in the asphalt concrete, it should be reabsorbed by the Advera WMA and bound in place. Once in-place, the Advera WMA behaves as mineral filler. Better workability means easier handling and higher densities even with stiff mixes. The ability to increase RAP and RAS, obtain density bonuses, extend the paving season and increase haul distances are measurable benefits of Advera WMA.

This pilot road research project aims to determine the influence of using technologies that reduce the production and construction temperatures of asphalt concrete mixes on the performance of the mix. Specifically, this study aims to develop practical guidelines and specifications, and establish mix design framework for WMA on the use Advera as an admixture in asphalt pavement to improve the inherent physical properties and characteristics as well as the resistance to rutting of the resulting asphalt pavement.

The Advera product had been submitted to this Bureau by the proponent pursuant to and in accordance with Department Order No. 189, series of 2002, *Revised Procedures for New Product Evaluation/ Accreditation,* which is a mandatory requirement for relatively new products/technologies that are not yet covered by any existing standard specification prior to incorporation into DPWH infrastructure projects. Laboratory evaluation was executed to ensure that the product introduced addresses the Department needs.

Based on the submitted samples, it yielded to positive results and satisfactorily complied with and completed the 1st Stage of the Product Accreditation Scheme (Section 3.1 of D.O. 189, s.2002, *"Evaluation of Product Characteristics, Applications and Test Methods"*) and is now ready to undergo the 2nd Stage of accreditation which is the Construction of Small – Scale Pilot Trial.

Pursuant to Department Order No. 189 series of 2002, section 3.2.1, upon *conforme* of the proponent, two (2) small-scale pilot trials shall be scheduled for construction to verify the performance of the product (Advera) under local conditions, e.g. weather, traffic, etc.

The first pilot trial section is located along the stretch of East Service Road, Paranaque City, Metro Manila (South Bound) and constructed in a flat terrain in Paranaque, having a fair sub-base/base which comprises a total length of 768 linear meters long, two (2) lanes having a width of 3.50m each lane with a 50mm thickness. Conventional construction of asphalt overlay was also implemented for the comparison with the new introduced technology. The pilot trial is composed of four (4) sections including the conventional – Item 310 Bituminous Concrete Surface Course, Grading "D" and the remaining sections with the new product, Advera.

In addition, the second pilot trial section is located along Paniqui - Camiling - Wawa Road, Km.157+195 to Km.157+955, Burgos Section, Paniqui, Tarlac. It was noted that most of the said section was overlaid by asphalt which covered any physical defect the concrete might have. The selected road project site can be considered to be a fair sub-base/base which comprises a total length of 760 linear meters long, two (2) lanes having a width of 3.05m each lane with a 50mm thickness. Like the first pilot trial, a conventional construction of asphalt overlay was also implemented for the comparison with the new introduced technology. The pilot trial is composed of three (3) sections including the conventional – Item 310 Bituminous Concrete Surface Course, Grading "D" and the remaining sections with the new product, Advera.

The manufacturing of Warm Mix Asphalt is the same with the conventional asphalt mixture except adding Advera. The mixing temperature is made 20°C to 30°C lower than the mixing temperature of conventional asphalt. After laying and compacting the asphalt pavement, the two constructed pilot trial projects were noted to have an immediately fatting up/bleeding of asphalt.

In accordance with the DPWH Department Order No. 189, series of 2002, section 3.2.7, this Bureau together with the proponent shall monitor the performance of the product (soil stabilizer, concrete additives and asphalt admixtures) for one (1) year; monthly during the first six (6) months and then quarterly during the next six (6) months. Performance of the pilot project was monitored through the conduct of visual observation, mapping of cracks, skid resistance test, sand patch test and rutting test.

Both pilot trial projects used the same construction methodology as the conventional asphalt pavement being constructed. Aside from the composition of asphalt mixture, the only difference is that the mixing temperature, hot mix asphalt concrete is produced at temperature between 300 - 330°F. With the addition of up to 0.25 wt% Advera warm mix asphalt mixes can be produced and compaction at temperatures 50 - 70°F lower.

The comparative cost analysis revealed that warm mix asphalt (Advera) pavement is expensive to use compared to the conventional asphalt pavement being used in the government projects. The use of warm mix asphalt technologies in asphalt mixes has clear benefits when compared to hot mixes. These include significant reductions in, or even elimination of, smoke and odors, lower emissions, improved workability, better working conditions, and better performance on projects with long hauls or where mixes are placed under cool conditions and has a lower chance of error. The slightly higher costs of using warm mix technologies are outweighed by these benefits. Care should also be taken on selecting

production temperatures for mixes that will be placed on roads with heavy truck traffic in hot climates, as the lower initial oxidation of the binder associated with low production temperatures may lead to early rutting

Based on the monitoring of the performance of the two pilot trial, it shows that the skid resistance or the frictional characteristics of road surface of the warm mix asphalt (Advera) met satisfactorily the required minimum value of 55. In addition, the average texture depth measured on the said pilot section passed the threshold value of 0.50mm which can be categorized that the pavement is sound and no visible stresses can be seen. The control section or conventional asphalt pavement was constructed for the purpose of evaluating the new introduced technology by comparing their performances based from the monitoring test being conducted. The conventional or control section and warm mix asphalt have almost the same skid resistance and texture depth value which satisfactorily passed the requirement value of 55 and 0.50mm, respectively. Further, there were rutting measured on some test location and has a rut depth of more than 10mm and some test location has a rut depth of less than 10mm which still passed the required threshold value specified in the United Kingdom's DFID. Bleeding/fatting up of asphalt are the common distresses on both pilot trial project.

Lower process temperatures mean reduced emissions. VOC's, CO2, SOx and NOx emission are reduced up to 60%. Reduced emissions result in a healthier environment around an asphalt concrete plant, during transport of the mix, and at the paving site. Lower temperature also equates to energy savings up to 30%. By adjusting the burner tuning to allow WMA process to operate at a lower setting, these energy savings and emission reduction could be greater. In addition, a lower temperature used during the production also accounted for the reduction in energy usage to mix the material, as well as to transport the material through the plant.

It is recommended that Warm Mix Asphalt (Advera) can be used as an alternative asphalt paving material especially in highly urbanized areas where heavy traffic loads can be experienced. This new technology will help the government to lessen the cost in rehabilitation and preventive maintenance projects in the future.

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