INTELLIGENT COMPACTION IS A “SMART” INNOVATION

IC offers contractors and agencies a new tool for improving pavement service life

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“It seems that major innovations in compaction technology come along about every thirty years. The last major innovation in rollers that compact pavement materials was the vibratory roller, which came out in the mid 1970s.” says Chris Connolly, national sales manager for Bomag Americas. “Now, thirty years later, the latest significant innovation is Intelligent Compaction. Interestingly, Intelligent Compaction technology is generally applied using vibratory rollers.” Bomag is one of the roller manufacturers that have developed advanced IC technology for use on both single and tandem drum rollers in the North American market.

Asphalt Institute is partnering with FWHA to study and implement the use of a new technology called Intelligent Compaction (or IC for short) in the United States. IC is an exciting innovation that provides some smart solutions to some of the shortcomings in currently-used compaction equipment and processes. It offers many benefits to both the roller operator and to the agency.

Benefits of Improved Compaction

In the Spring 2008 issue of ASPHALT magazine, I wrote an article about IC titled “INTELLIGENT COMPACTION – A new tool for improving asphalt pavement compaction”.

http://www.asphaltmagazine.com/singlenews.asp?item_ID=1453&comm=0&list_code_int=MAG01-INT

That article addressed some of the basic questions related to the use of IC for compaction of asphalt pavement materials, including: What is Intelligent Compaction? How does IC work? It also made a case for the importance of compaction in the HMA construction process. The article asks and answers the question:

“How important is the compaction process in obtaining a quality, long-lasting asphalt pavement? Virtually everyone agrees that it is more than important—it is critical. Poorly compacted pavements just do not perform up to expectations. That poor performance is unacceptable in an environment where the cost of materials and construction are at all-time highs.” The article goes on to explain why IC offers the capability to improve the compaction process and provides a valuable tool for better QC/QA. This improvement in the process and quality management of the compaction process should translate into better pavement performance. Why? Because IC provides many benefits that make it better than conventional compaction equipment and processes, including:

• provides “real time” feedback to the roller operator and project personnel during the compaction process using on-board, color-coded mapping capabilities. This allows the operator to get more consistent roller passes and to identify problems during the compaction operation.

• helps with identification of “soft spots” in underlying materials prior to placing the subsequent layer. This can help to identify areas where repairs are necessary and can help explain low density.

• potentially can be correlated with in-situ testing results (like density or stiffness/modulus tests), which could allow for reduced QC/QA testing and personnel. Research is ongoing in this area but early results show promise.

• saves money by making the compaction process more efficient and effective. This is an obvious benefit for the contractor but ultimately will also be an advantage for agencies.
Todd Mansell, Technical Service Coordinator for Sakai America stated, “I believe whether IC rollers are specified or not, paving contractors who use IC technology will not only produce a higher quality product, but they will become more competitive than those who do not.”

**IC Roller Suppliers**

Almost all of the major roller suppliers in the United States are conducting their own research and incorporating IC technology. In addition to Bomag, Case (Ammann), Caterpillar, Dynapac, Volvo and Sakai are currently offering IC to customers or have stated that they plan to offer it soon. Bomag and Sakai are the two manufacturers that are currently offering tandem drum rollers for asphalt materials, which meet the basic criteria established by FHWA to be considered an IC roller. In short, that means the tandem drum roller must have a stiffness measuring system, a mat surface temperature measurement system and a GPS-based documentation system to be considered an IC roller.

Figure 1. Bomag and Sakai offer tandem drum IC rollers that meet the FHWA criteria for IC. Shown here are the Bomag BW 278 AD (left) and the Sakai SW 880 that are equipped with IC capabilities.

**IC Research Project**

Over the last five years, extensive research on IC technology has been performed on field projects around the country, including a NCHRP project that was completed in 2008. I have been involved with a major research effort called the Intelligent Compaction Pooled Fund (ICPF), which is a three year study involving field projects on various pavement materials in 12 states. The research is called DTFH61-07-C-R0032 “Accelerated Implementation of Intelligent Compaction Technology for Embankment Subgrade Soils, Aggregate Base, and Asphalt Pavement Materials”. The 2010 construction season is our final year of the ICPF and four field projects are planned in the states shown in green (VA, PA, WI and ND) in Figure 2. Planning is now underway with these states, IC roller manufacturers and the research team to select material types to be studied, to identify appropriate projects and to select tentative dates. It is anticipated that the projects will be completed, the collected data will be analyzed and the final report will be published to wrap up the ICPF by December 2010. The results of the research will be presented during an IC workshop at the 2010 Transportation Research Board in Washington DC. A website dedicated to the subject of Intelligent Compaction has been created through the ICPF project (www.intelligentcompaction.com).
Figure 2. Intelligent Compaction Pooled Fund States and Year of ICPF Projects

Benefit of Color-Coded Displays

As mentioned previously, on-board displays are an important feature of IC technology. Figure 3 shows a color-coded display from a Sakai tandem drum asphalt IC roller, which is placed in direct view for easy use by the roller operator. This display brings together the various features of IC technology (stiffness measurement system, mat surface temperature readings and highly accurate GPS documentation system) in a color-coded map of important things for the operator. It can be switched to display color-coded maps of materials stiffness, surface temperature or numbers of roller passes. The display provides the operator with an innovative tool to better do their job of uniformly compacting the pavement material to meet project specifications.

Figure 3 shows a display of roller passes on an actual project where three roller passes were required during the breakdown phase of compaction. If you study the color legend on the left side of the display, you can see that red is one pass, yellow is two passes, blue is three passes and green is four or more passes. Note that the roller icon is shown in its “real time” location. In this case, the roller has been applied three passes (blue) in the left lane except in a small area where only two passes (yellow) have been applied. In the right lane, the operator can see that he has placed one pass (red) on the right lane. The green strips show the overlap between rolling lanes. It is easy to see that this user-friendly display is simple to interpret by the operator, who can apply the required number of passes simply be making the display blue (required three passes on this project) before moving on to the next section of pavement to be compacted.
Figure 3. On Board, Color-Coded Display on Sakai tandem drum IC roller showing “real time” image of total number of roller passes applied to a HMA

The Future of IC

It is probably not an exaggeration to say that Intelligent Compaction is an innovation that will play a major role in compaction technology in the future. The adoption of IC just offers too many benefits to be ignored. We are already seeing roller suppliers making major commitments to add IC capabilities to their products and agencies moving toward use of IC in their QC/QA efforts. Asphalt Institute will continue to take the lead in working with suppliers, agencies and FHWA to study and implement this important (and smart) innovation.