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Clean Sweep

Byline: John Barton

Vast amounts of bulk materials (coal, aggregate, ore, etc.) are involved in commercial transactions where current weighing technology has provided substantial improvements in determining accurate weights for those types of products. However, determination of the weight or measure of these products is not the entire basis for establishing their value. Within these transactions, product sampling and analysis also plays a critical role in determining the fair market value of a product based on its characteristics. Characteristics such as composition, moisture content, purity, etc. are determining factors used in the assessment of the value of the material and have a major effect on the terms of contracts and the sale of these products.

There are a number of sampling methods for bulk materials in use as standard industry practices. The primary variation between methods of sampling is related to the mechanics involved in extracting the sample and at what stage within the production process the sample is collected. Although there are significant differences in the methodology, industry standards such as ASTM D 75/D 75M-09 and E 105-04 require that whatever procedure is used, the sample must be collected randomly and must be representative of the total load.

One particular type of sampling procedure that has received increasing attention over the past fifteen years involves the use of “sweep samplers.” This type of sampler system has gained popularity in the bulk materials handling industry for several reasons. Among the reasons cited for selecting this method of sampling are:

- These systems are comparatively simple in design and provide an economical option that can be installed and placed in service on new or existing conveyor belt lines;
- Samples may be obtained rapidly and without the necessity of temporary stops of the conveyor belt system; and
- They offer a programmable method of obtaining a representative sample without the need of an operator in attendance.

Sweep samplers are a type of “cross-cut” sampler that operate by removing a cross section of material perpendicular to the direction of belt travel while the belt is in motion. There are a number of companies that manufacture this type of sampling equipment, and a variety of designs are available on these systems. The following web address can be used to access two videos that demonstrate the mechanical action of this type of sampler. These videos show the actual operation of the sweep-action type of sample collection and will provide the reader a better understanding of the operation than can be accomplished through literary description.

Link to access videos: <http://cspot-run2.nist.gov/pml/wmd/lmdg/test-videos.cfm>

In spite of their popularity, these systems do present concerns within the community of belt-conveyor scale users, manufacturers, and regulators. In proportion with the increase in the number of systems being installed, questions have arisen regarding the operational mode of sweep-samplers during the testing of the belt-conveyor scale systems with which they are associated. Additional concerns regarding the potential effects that sweep samplers may have on belt-conveyor scales during normal operation are also being expressed. As a result, answers are being sought regarding recommendations or requirements for locating the sampling system, relative to a belt-conveyor scale in the same belt line.

The National Institute of Standards and Technology (NIST), Weights and Measures Division (WMD) have received a number of recent requests seeking guidance for the correct installation requirements for these samplers in relation to a belt-conveyor scale. While there are no specific references to sampling systems in NIST Handbook 44 (HB 44), *Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices*, some industry personnel have referenced HB 44 requirements pertaining to the placement of other conveyor components such as: training idlers; skirting; loading points; etc. The minimum distances required in HB 44 for placement of these belt-conveyor features are based on evidence that contact made with the belt by these features will impart a measurable degree of influence to the belt tension and/or speed, thereby affecting the performance of the belt-conveyor scale. In the same sense, contact with the belt by the mechanical operation of sweep samplers could potentially have similar effects on the weighing process.

In an effort to acquire information that could be used to establish standards, several U.S. manufacturers of sweep style samplers have been contacted by NIST WMD to determine if the engineering departments of those companies supplied their customers with guidance on this issue. None of the manufacturers who responded have policies where their customers are provided instruction or recommendation on where to locate the samplers to negate any effect the sampler could have on a belt-conveyor scale's performance. Service technicians and installers of belt-conveyor systems have pointed out the lack of requirements in HB 44 that specifically address the placement of sampling equipment.

These types of samplers are capable of operating autonomously and repeatedly as set in their programming. Given the split-second nature of contact made with the belt-conveyor, one might assume that any effect would be minimal. Consider, however, that a sampler is programmable and may be set to operate several times within relatively short time periods. Although the number of samples required will vary based on time of operation or material flow, operators of these sampling systems have provided examples of sampling rates, some as often as once or twice per minute. The cumulative effect could have a significant impact at the conclusion of an extended weighing process.

Placement of samplers downstream of the belt scale will result in product that has been included as a portion of the full load to be removed from the delivery of that entire load. Typically the amount of product needed for sampling is small and the amount of a single sample in relation to a totalized load would generally be insignificant. The removal of product from the stream of flow repeatedly throughout the process, however, could conceivably have a significant effect on the totalized load. Because this method of sampling would result in a diversion of measured portions of the product, many weights and measures authorities would consider this method of operation unacceptable.

In addition to the placement of sweep samplers, other concerns involving this type of sampler include the recognition that repeated sample collection during an entire weighing process results in areas of the belt stream that are devoid of product. This condition is in contrast to the optimum operating

conditions of belt-conveyor scales that stipulate a steady and consistent flow of product across the weighing element.

When responding to requests seeking guidance for the proper location of the sampling equipment, NIST WMD has received anecdotal information indicating that sampling equipment is routinely being turned off during official testing of belt-conveyor scales in many, if not most instances. HB 44 General Code addresses this issue as follows:

G-UR.3.2. Associated and Nonassociated Equipment. – A device shall meet all performance requirements when associated or nonassociated equipment is operated in its usual and customary manner and location.

(Added 1976)

This requirement indicates that the intent of a performance test is to evaluate a system when all of its components are in operation. Sampling systems are typically in use during normal operations. Therefore, any official testing should be performed with the samplers running. Considering the sweep sampler's operation, it is reasonable to assume that the potential exists for a belt scale located on the same conveyor to be affected by the mechanical action of the sample being taken from the belt. This would be justification for the recommendation that sampling systems of this type be in operation during official performance evaluations.

The NIST WMD response to many questions regarding weighing and measuring devices is based on existing standards and an experienced knowledge base. The response to questions posed regarding location of sweep sampler installation, however, requires information that is not yet available. Any studies performed in an attempt to gather data would be complex in nature and would have to overcome difficulties, most notably the need to avoid any interference with normal plant operations at the testing site. To date, no equipment manufacturers or industrial operations have been identified as a potential source for this data. Provided that a suitable site could be located, the process of data collection would also require personnel to perform the required test procedures, obtain all necessary test equipment, and procure and weigh material to use in the testing.

Many interested parties involved with the use of belt-conveyor scales and associated equipment would stand to benefit from further data collection of sweep sampler operation and impact. These parties are anxious to receive guidance that can only be based on legitimate data. For comments or information relevant to the content of this article, please contact:

John Barton
National Institute of Standards and Technology
(301) 975-4002
john.barton@nist.gov

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Videos courtesy of JBL Co.
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Internet Website: <http://www.jblco.com/>

- A.M. Long
Author of "Maintaining Coal Sampling Systems, Managing Objectives with Limited Resources"

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