# Monitoring And Controlling Carpet Coating

**By G. Schellenberger,**
Mahlo America, Inc., Spartanburg, SC

**Introduction**

The process of applying the preliminary back coating to an uncoated carpet can be optimized through the use of an on-line weight monitoring and control system (Figures 1, 2). The process can be best explained by an outlines of the potential savings that can be achieved through the use of such a system, the principle of the measurement itself, the application of a beta gauge system to a coating process, and the issues that revolve around the installation of a radioactive isotope.

It's no secret that the correct add-on of coating must be carried out carefully in order to achieve the proper handle and stability within the carpet. However, fluctuations in the amount of coating applied cannot be avoided, regardless of which method of coating is adopted. At frequent intervals, spot checks are necessary to determine the weight of the substance applied, and this is achieved by cutting samples from the carpet and weighing them. However, this method is no substitute for constant monitoring of and direct intervention in the coating process. Moreover, removing samples by punching will destroy a large amount of material, as the following estimate demonstrates.

Assuming that eight samples are taken on each shift, thus ruining 1 ft. of carpet, 12 ft. width each time, at 3 shifts and 250 working days a year, this adds up to 1 x 12 9 x 8 x 3 x 250 = 8000 $y^2$/year. Hence, with an assumed average price of $6 per square yard, controlling the weight by taking samples costs $48,000 per year - which would almost pay for an appropriate measuring instrument. Because add-on fluctuations cannot be avoided for whatever reason, to be on the safe side, it is customary to apply more coating substance than is really necessary. Fluctuations in the weight of coating of ± 2 to 3 oz/$yd^2$ with a target weight of 24 to 36 oz/$yd^2$ are not unusual. Thus, the mean coating weight must be far removed from the level at which a definite quality impairment is perceptible.

**Controlling fluctuations**

If these fluctuations in add-on levels could be reduced to a fraction, they would lead to considerable cost savings, in this case, in respect to the price of the coating substances. With an annual production of 25 million square yards of carpet, one ounce less preliminary coat (if up to now, for instance, 35 ounces had been applied instead of 34 ounces per square yard) would mean some $280,000 in savings per year.

These figures would impress even the most conservative management team. The contact-free determination of the weight of applied substances on on-line goods is, therefore, here to stay and has been gratefully accepted by the operatives responsible for the coating process in every mill in which this instrument has been installed. Initial misgivings regularly have given way to surprise over the inadequacies that suddenly came to light.

For contact-free measurement of the weight of applied substances on on-line goods, measuring instruments are used which determine weight as a function of the mass-dependent absorption of radioactive radiation. Absorption follows the formula

$$J = J_0 \times e^{-kF}$$

$J_0$ = output of the radiation source
J = residual radiation behind the carpet
F = weight per unit area
k = material constant

The radiation source is normally a radioactive isotope, the type depending on the weight per unit area that is to be measured. In the case of carpets, the weight usually ranges between 500 and 5000 g/$m^2$. The isotope normally used for this purpose is Strontium 90 (Sr 90), which emits beta rays (electrons), which, after passing through the carpet, can be detected in an ionization chamber. The current in the ionization chamber as the result of the beta radiation is a measure of the material in the cross sectional area being scanned and, with appropriate calibration, and for the area weight of the on-line carpet.

The intensity of the radioactive isotopes is reduced as they are beamed through matter, in this case, both the uncoated carpet and the aqueous coating. If only the weight of the coating is to be displayed, a differential measurement is necessary. This means that the raw weight before coating and the weight of the coated carpet are determined separately, the difference between the two being the weight of the coating. The important point is to ensure always that identical sections of carpet are compared with each other. For example, with high-low qualities, variations in area weight are a very real possibility. In such cases, the integration of a memory means that the signal from measuring point 1 is delayed until the measured section of carpet reaches measuring point 2 (same spot measurement).

**Third measurement**

If the weight of the dry preliminary coat is also measured with a third measuring head, it is possible, provided the drying effect is consistent, to monitor the consistency of the preliminary coat. This provides insight on whether the mixer is operating properly.

**Figure 1**–Main display: This display indicates in columns M1 and M2 the readings provided by the scanners at two monitoring points (FMI1 and FMI2). The third column registers the computed difference in weight between the two (FMI-DIFF).

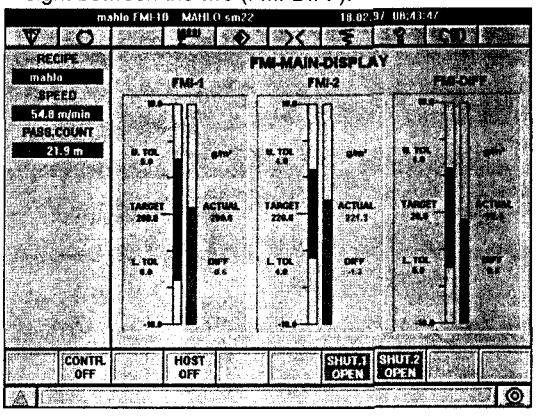
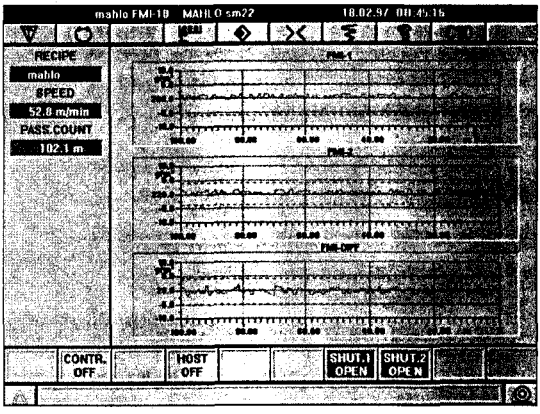



**Figure 2**–Trend display: Separate histograms can provide a ready reference of any variations in the weight registered by the two scanners and the difference between the two, over either a variable period of time, or number of meters.




The accuracy of the radiometric area weight measuring process is high, being around 1% of the application weight. Modern equipment is self-calibrating, thus compensating for the natural disintegration of the isotope (half-life period for Strontium 90 = 27 years).

It is possible to display both the actual weights of the uncoated and of the coated carpet as well as the weight of the coating and any deviation from a preset target weight of coating. With the automatic control of the coating process; one can achieve the closest weight tolerances and become independent of the inadequacies of the operatives. The functions include control of the speed of the padding rollers or the adjustment of a downstream doctor blade in small increments, sensitively and without overrun.

The question about whether a single fixed measuring head location is adequate despite the variations in coating weights over the width of the carpet, is discussed repeatedly, and usually one fixed measuring head in the middle of the carpet is decided on. In principle, the measuring heads could be fitted so as to traverse across the carpet, thus scanning the profile of the entire width of the carpet in a zig-zag motion. However, since different coating heights can at best only be allowed for by having a doctor blade in an inclined position, such traversing action would only serve to bring to light existing shortcomings, yet not provide the means to eliminate them.

## Separate measurements

It is more practical to measure the weight of the coating near the edges by having two separate measuring units and control the corresponding side positioner of the blade coater. The differences in the coating over the width could at least be compensated as a whole. In addition, the use of two units has the great advantage that differences in weight can be detected constantly, not periodically as in the case of a relatively slow reciprocating action of the measuring head.

Radiometric measuring methods automatically mean the use of a radiation source. Radioactivity and radiation are currently provocative terms to say the least, hence, comments are in order on the subject of protection against radiation.

The effect of radioactive radiation on a human being goes unnoticed, and if exposure exceeds a certain dose rate, this can be noxious. Therefore, to protect the population, in most industrial countries, it is usually necessary to have a special permit authorizing the handling of radioactive material. However, radioactive radiation covers a wide spectrum, from the constantly omnipresent cosmic rays and the radioactivity from the ground, which everyone is subjected to, to the acute tissue-destroying radiant energy, as is used for medical purposes.

The radiation sources used in area weight measuring instruments have only a very low activity. They are encased in steel, radiation-proof housings. Beta radiation, the radiation used for measurement, is normally only released when the system is switched on; a weak secondary gamma radiation, which is also emitted, is usually so reduced by the time it is outside the radiation-proof housing, that any danger to the machine operators is eliminated. During operation—when the unit is switched on and the radiation emission aperture is open—the operatives may be in the immediate vicinity of the aperture of the Gravimat (Mahlo), for example, for the short time required for threading-in operations, with absolutely no misgivings.

Moreover, for one day every week, the operative may stay within a distance of at least 70 cm away from the emitter with no detriment to health. The annual dose rate to which he is exposed in this case does not attain the level permitted by law—which is calculated with adequate safety margins in any case.

## Conclusions

The use of an area weight-measuring unit does not, therefore, harbor any real danger for the operatives. It goes without saying that the carpet itself is in no way radioactive after being subjected to a measuring technique. □ □ □