Maguire Blender Dispense Accuracy

For all Maguire Weigh Scale Blenders

The question of accuracy comes up frequently. It is a confusing subject. There is no accepted standard in the plastics industry to express accuracy. It is common for this industry to express accuracy as simply plus or minus a percent, without telling us, or even knowing what this number means. When pressed for an explanation, it is rare that anyone knows the basis for their claim. I personally believe that marketing pressure requires that we all make claims at least equal to our competitors without really knowing how these numbers are derived.

Take, for example, the accuracy claim of plus or minus 1 percent. We might ask:

Percent of what?

If we wanted to dispense 4 percent colour, does plus or minus 1 percent mean a dispense range of 3 to 5 percent colour is to be expected, (which is plus or minus 1 percent), or is it 3.96 to 4.04 (which is also plus or minus 1 percent). How about sample size? Is this accuracy achieved after a single dispense of 10 grams, or over a much longer run of say 100 kg.

One percent of 10 grams is about 4 pellets of colour, not a realistic goal from an auger that dispenses about 360 pellets with each turn. In addition to the irregular shape and size of the pellets, augers have an unfortunate pulsating output due to auger flight interference. About 2/3 of the pellets (about 240 pellets) are dispensed in the first half of a turn, while the other 1/3 (120 are dispensed in the second half of the turn. How can you predict what degree of rotation will cause 4 pellets, or even 100 pellets, to fall since 180 degrees of rotation can dispense anywhere from 120 to 240 pellets.

100 kg, plus or minus 1 percent, is, on the other hand, a very achievable accuracy goal despite the pulsating output of the auger. Even the irregular shape and size of the pellets will be averaged out over such a long run.

In our sales literature we claim for our blenders an accuracy of plus or minus 1/10 percent. If you want 4 percent colour, are we saying you will get 3.9 to 4.1, (which is plus or minus 1/10 percent), or do we mean you will get 3.996 to 4.004 percent colour (also plus or minus 1/10 percent). We actually do mean the second example, that is 1/10 percent of requested target, the more difficult goal to achieve.

However, we can achieve this goal only over time. Only with pellets that are fairly uniform in shape and weight. Only if the hopper material level is held steady (an aid to uniform metering), and only if internal parameters are set correctly.

When these conditions are met, it is not uncommon for the actual colour quantity dispensed over 20 or 30 cycles to be within a few grams of the exact calculated target amount. As long as the requested target amount is large enough, say 4 percent, or 80 grams, per batch, and we run enough batches, say 30, then we can achieve our 1/10 percent accuracy claim.

A slide gate set to dispense 2000 grams per cycle, 10 cycles in a row, can achieve a total dispense weight within 10 grams of the 20,000 gram target. This also meets our claim of 1/10 percent accuracy. But let's take an example under the worst conditions; blender batch size is 2000 grams, regrind usage is 50 percent, and you want to add ½ percent colour to the natural portion. In this case you are looking to dispense 5 grams colour each cycle. A one inch auger has a known predictable dispense error of 2 grams due to the pulsating output of the auger, something that is true of all augers. Our Micro Pulse valve is better than an auger but it cannot be perfect every time. So you can expect, and you should expect, errors of 2 grams batch to batch. Two grams is a FORTY percent error from the requested five gram target.

No one will publish such an error in their literature, but all of us, customers and suppliers alike, must deal with this reality. This is not to say that it is impossible to get it exactly right if we had to, we could. But the time required to dispense slowly, a few grams at a time, followed by careful weighing and even smaller corrections, would consume valuable time. Process throughput rate would be far too low. Another way we could do it is with much more equipment, very expensive equipment, more complicated and probably less reliable equipment. If the industry absolutely required this, then this would be done.

But let's look at the reality of the process and the needs of the industry. Even in our example above showing 40 percent error, we are only talking about a few grams. The batch that follows will most likely produce an equal error in the other direction. In fact, "pulsation" errors occur plus and minus equally. The blender mix chamber holds about 3 batches so there is averaging going on in the mix chamber. In addition, all plastic processing machines contain a barrel which holds up to 3 or 4 or more blender batches and a screw which vigorously blends all these components together. The blending action of the screw is what allows a single colour pellet to typically colour 25 times its weight in Natural and do it very well. In fact, in a 100mm extruder, 1 colour pellet will disperse across 500g of natural material, a blend of 1 part to about 15,000 parts. We see this when 1 stray colour pellet, red for example, enters the flow of what is supposed to be a white product. About a 500g of "light pink" material will be scrapped due to contamination from this single pellet.

The very substantial mixing that occurs before the final product is produced assures us that one or two grams of colour error per cycle has no impact on the quality of the final product. In fact, blending is so complete that even in careful lab analysis, these errors are not detectable. Blender design is geared to deliver exactly what the plastics processor needs, consistent accuracy over time, with batch to batch errors low enough so that the blending of the process makes these errors undetectable in the final product. This we do.

Here are some of the details as to how we do it:

Load cell resolution is 1/40 of a gram (about 1 pellet). This means that in the "raw signal" readout mode, the addition of 1 pellet to the weigh bin will cause the output reading to increment by 1. This is what the circuitry can detect. Software resolution is 1/10 of a gram (about 4 pellets). All weights that are taken and recorded by the software are in tenths of grams (full grams for larger models). This is what the software records. Over an extended time period the system is extremely accurate. Every batch is followed by an error correction routine that assures that the next batch "learns" from any significant error that might have occurred. In this way the system continuously, but cautiously, hunts toward perfect average dispense weight.

Accuracy of the dispense of any one component in any single batch depends on the repeatability of the dispense device.

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