DO YOU ACTIVELY CONTROL VOLUMES AT THE FILLER?

Product control in the beverage industry

Even with ostensibly homogeneous products, packaged weights tend to vary among different producers – sometimes significantly. While some manufacturers manage to hit declared filling quantities more precisely on average, avoiding underfilling, others seem to routinely overfill, unnecessarily driving up material costs.

Packaging accuracy is regulated in Germany. Actual volumes are checked at irregular intervals by the Calibration Office (Eichamt). In the event of underfilling or chronic volume variance, manufacturers may be hit with fines and, if deemed necessary, further regulatory measures. In addition, they risk public image loss.

What exactly does the packaging regulation require of manufacturers?

Basically, there are three criteria that manufacturers must comply with (see Figure 1):

1. The average of all filled weights must be at least equal to the declared quantity. For example, with a specified declared capacity of 750 ml, a weight of 750 ml can be achieved on average across all containers (with some individual containers weighing less than 750 ml).
2. A maximum of 2 percent of all filled containers may fall below the technical lower limit 1 (TU1). The TU1 is defined in the filling ordinance depending on the filling weight or filling volume and amounts to 15 ml for a product with a declared filling volume of 750 ml. Thus, in this example, a maximum of 2 percent of containers may weigh less than 735 ml.
3. Not a single container may fall below technical lower limit 2 (TU2). The TU2 is twice the TU1, i.e. in the case study 720 ml.

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For companies in the beverage industry, the central challenge now is to comply with the regulations and at the same time to avoid overfilling as much as possible – for obvious economic reasons.

Following are 10 practical tips to help successfully optimize filling quantities:

1. Measure accurately

All optimization efforts must be based on meaningful and accurate data recording. In practice, however, these records may, in many cases, be flawed. For example, for automatic weighing systems, where each individual item is weighed, a so-called tare (empty weight) is deducted to determine the net weight of the filled container.

However, as the container itself is subject to weight fluctuations, this tare should be checked regularly. The net weight of cans, PET or glass bottles should be automatically recorded and statistically analyzed per container and filling machine. If no automatic weighing system is available in the filling process, individual samples can be weighed at predetermined intervals. For a detailed analysis of the performance of the filling process, it is essential that the weighings take place within short time intervals in order to be able to detect any possible fluctuations in the process.

2. Work digitally

In many cases, collecting weight data is still carried out manually and paper-based. This data is generally not accurate enough to be used for a comprehensive analysis of all products and process steps. Therefore, it is crucial to work system-based and record the weight data digitally. As a first step, a simple Excel spreadsheet is sufficient. Care must be taken to ensure that the data is recorded in Excel in such a way that flexible evaluations by product and filling time are possible. In the event of major deviations or increasing variations in the filling process, digitizing existing paper data is necessary.

3. Expand data collection parameters

For detailed monitoring of filling performance, fully automated control of all processing steps is ideal, whereby the scale stores all weighing data in digital form, making it available for accurate reporting and assessment. In the vast majority of cases, manual weighing covers only a small percentage of the filled containers, so that most of the product is bottled “blindly.”

In addition, the scope for manual processes is significantly narrower and the results more error-prone. Ultimately, analysis results for large amounts of data are much more meaningful, so that optimization strategies can be more targeted. Therefore, whenever possible, full automation of all process steps is recommended. In particular, weight and volume control measures should be implemented when investing in new equipment, such that automated and statistically sound analyses are ensured at all weighing stations – which should always be state-of-the-art.

4. Calculate mean and standard deviation of weight distribution

Most manufacturers collect average weights on a strict schedule, whether via fully-automated control mechanisms or regular sampling procedures. However, the mean alone is not sufficiently reliable to fully assess filling performance because variation among averages is equally crucial. While high variations do cause declared weight to be achieved on average, there is an increased probability that there might be packages whose weights are less than TU2, which means the maximum value of 2 percent of the packages that are between TU1 and TU2 is exceeded and the calibrators draw underfilled items as part of the random inspection at a higher rate.

To compare different items,it is more logical express the mean as a percentage of the declared filling volume (this corresponds to the average percentage of overfill or underfill). Further, it is advisable to represent the standard deviation as a coefficient of variation (standard deviation divided by mean value) to represent this absolute volume as a relative value.

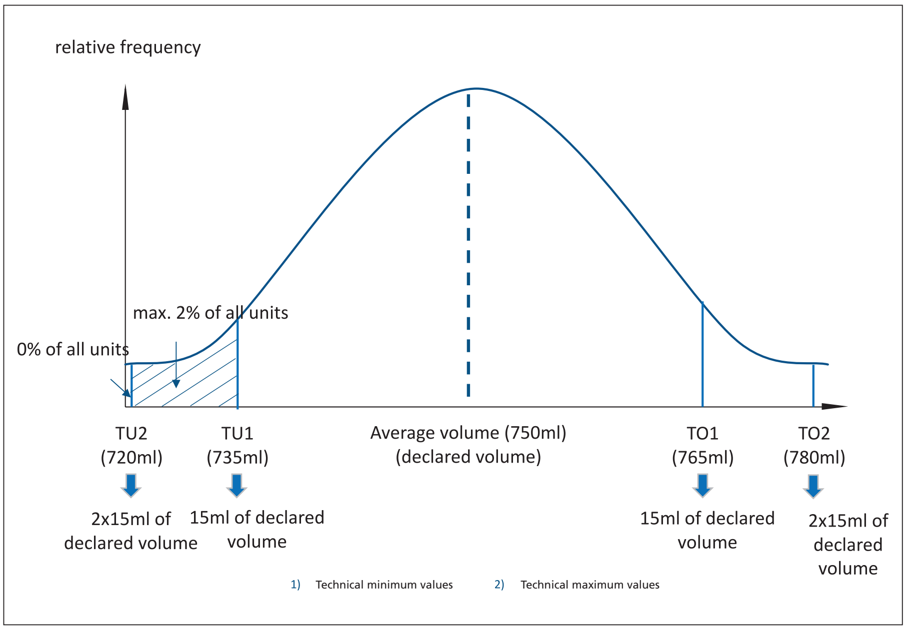

Figure 1: Filling volume optimization

5. Define custom optimization strategies for each product that passes through the filling station

Based on product classification by mean and fluctuation range, individual optimization strategies for each product can be derived. Items that are, on average, underfilled do not meet one of the key criteria of the Filling Quantities Ordinance. In this case the filling quantity must be increased immediately. If fluctuation parameters are high and overfilling is low, volumes can be readjusted in the short term, as there is an increased probability that the Calibration Office will measure below-average values, and thus the declared filling volume average is not achieved. In the case of higher overfilling averages with high variations rates, the risk of being red-flagged by the Calibration Office is initially lower. However, this added security has a cost. Therefore, the objective is to reduce the variation in order to be able to reduce filling quantities, thus saving material costs. Especially for products with low variations and increased filling volumes, short-term cost-cutting potential is significant.

This overfilling should consequently be avoided due to the added material expenditure. Adhering to best practices will ensure a lower variation and only slight overfilling. Since the variation may depend on product-specific factors such as CO_2 content, depending on technical equipment specs, it is appropriate to classify the product range with regard to the correctability of variations, thus allowing for further adjustment of optimization strategies.

6. Work with probabilities

As shown in point 5, not only an average underfilling of the packs can lead to failing the Calibration Office tests, but also a high fluctuation range of the filling weights. Since the test methods of the Calibration Office are precisely described in the Filling Quantity Ordinance, it is possible to determine the probability of failing the Calibration Office tests for each article individually with a few simple statistical considerations. This determined probability is almost never zero for the manufacturer (except for all containers which fall below the declared volume, which is economically disadvantageous).

If the company has determined a target risk, a target mean for the filling team can then be reverse-engineered if the variations is accurately reported.

7. Practice internal benchmarking

Whether you have full records or whether you still manually record the weight data of your products, internal benchmarking of the filling processes is beneficial in any case. Thus, you can identify and Compare precise processing steps, yet also monitor the performance of individual sections of the installation. This data-driven comparison not only quickly reveals opportunities for improvement, but can also be implemented in a timely manner, as long as the corresponding know-how exists in-house. At the same time, internal benchmarking can be set up quickly and implemented in a cost-effective manner.

8. Practice external benchmarking

For typical products in the beverage industry, it is quite reasonable to practice external benchmarking, as competitors' products can be readily purchased over the counter. For example, with a product price of 3 euros and a reasonable sample size of about 50 containers, the cost of external benchmarking is insignificant with 150 euros per item. Analyzing the accuracy of declared filling quantities reported by your competitors can provide important information about which process performances are achievable in terms of filling quantity and fluctuation range. In this way, purely theoretical comparisons can be ignored, since the competitor can indeed possess systems which enhance process performance. The example of a 750-ml bottle shown above demonstrates the magnitude of the potential to improve processes. For a medium-sized manufacturer with a sales volume of 50 million bottles, a 0.5 percentage point reduction in the use of materials with a material value of 0.25 euros per container already leads to potential savings of 62,500 euros. As a result of an external benchmark, variation between products among manufacturers are in some cases still significantly larger than 0.5 percentage points, so that the potential estimate given here is likely to be rather conservative.

9. Train your staff and give consistent feedback in a timely manner

An intensive study of the rules of the Filling Quantities Regulation should be a matter of course for all companies that send filled containers to market. Often, however, this knowledge is only rudimentary or concentrated in certain persons in the relevant production areas. In high-performance filling processes, employees who operate the filling lines should also know the intricacies of the final packaging regulation. In this way, filling processes can be more precisely managed. This requires regular feedback on filling performance, which includes not only the achieved mean, but also the variation of the process and the probability of failing the corresponding calibration test. Last but not least, filling performance could also find its way into any incentive system for employees.

10. Make only reasoned investments

In addition to training and guidance of staff operating the machinery, investment measures are another means of reducing fluctuation margins and average values during the filling process. For example, automatic discharge of significantly underfilled containers can help to increase the regularity of the process and reduce the need for a "security buffer" via systematic overfilling.

Another possibility is the introduction of so-called check-weighers, which transmit an automated adjustment command to the filler when deviations occur, thus reducing the probability of human error in the filling process. However, all investment measures require a detailed case study in which the potential that can be increased (beyond better employee guidance) via technology can be properly assessed.

Conclusion

For every company, dealing thoroughly with filling quantities is absolutely essential. Only a detailed analysis of mean values and variations can lead to reliable statements about the regularity and cost-effectiveness of the filling processes. While filling volumes of, on average, underfilled containers should be increased immediately, overfilling and higher fluctuation rates should be avoided at all cost. This can be quickly detected via analyses of operational procedures and external product comparisons. As a rule, significant potential can be realized without major investment as long as best practices are implemented effectively. Happily, this will nearly always result in reduced material costs. □

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