I HOLLAND®
TABLETTING SCIENCE

Every Tablet Tells a Story

Unique tablets require unique solutions - read on!

Dissolving Your Effervescent Issues

Effervescent tablets, or carbon tablets as they are sometimes called, are tablets which are designed to dissolve in water and release carbon dioxide. The carbon dioxide is generated by a reaction of a compound containing bicarbonate, with an acid such as citric acid. Both compounds are present in the tablet in powder form and start reacting as soon as they dissolve in water. They were first developed in the 17th and 18th centuries, when scientists were looking into the benefits of various salts, to replicate the mineral-rich waters that the citizens of the Roman Empire were said to have bathed in and drank for health benefits. Developments in their research led to them mixing these salts with flavourings like lemon, and citric or tartaric acid. These new products dubbed “fruit salts” were a hit with consumers! Since that time, effervescent tablets have been used as products in the pharmaceutical and dietary industries for over two centuries, right up until present day.

Their uses have since expanded beyond pharmaceutical and dietary into other applications, such as detergent tablets, like the ones used for laundry! However, compressing quality effervescent tablets presents production challenges, including sticking, abrasion, weight variations, and corrosion during production.

By understanding the root causes behind these challenges and implementing appropriate solutions, manufacturers can optimise their processes and ensure the consistent quality of effervescent tablets. In the past, I Holland has been able to solve production issues faced by customers compressing effervescent tablets. For example, a customer approached us facing two significant challenges while compressing a cleaning product into effervescent tablet form, The problematic product was a 20mm round-shape tablet produced using D Type tooling.

The cleaning product, was a degreaser with a corrosive nature, not only causing sticking problems during compression but was also leading to tooling corrosion, delaying the overall tablet production process, and as a result the operations efficiency. These issues were a cause of concern for the customer as they impacted tablet weight consistency and manufacturing quality.

The customer sought expert advice from I Holland to find a solution. After careful analysis, the adoption of tooling with polymer inserts, matched with the correct steel type, was recommended and offered several advantages, most notably enhanced corrosion resistance. Polymer or elastomer inserts are cut to match the tip shape and reduce sticking of the formulation to the punch face. Inserts options include a choice of different materials such as Vulcalon, Adiprene or PTFE. Their thickness can be chosen from either 1.5 – 2.0mm thick, depending on the requirements of the customer. Polymer inserts (PI’s) offer a good anti-stick solution especially for effervescent products, they also come with the benefit of being easily replaceable at a low cost. When looking at this solution, it’s important to remember that PI’s

are only suitable for flat bevelled edge and flat faced punches only.

As all tablet manufacturers will know, sticking poses a common and significant challenge during the manufacturing of effervescent tablets. Sticking is when the formulation adheres to the surface of the punch tip face. This build-up of granule results in tablet defects, which starts as a negative effect on the tablet appearance and can transition through other stages to double compression and potential damage to tooling and the press.

As a minimum, sticking results in the need for halting and removing tablet tooling from active production for regular cleaning and maintenance to remove the sticky granule, resulting in tablet press downtime and reduced productivity. The often-sticky nature of active pharmaceutical ingredients (APIs), combined with their hygroscopic (hygroscopic means capable of attracting and holding water from environment, through absorption or adsorption) properties and high moisture content, makes effervescent formulations particularly susceptible to sticking during compression. The underlying causes of sticking can be attributed to multiple factors in the production process including:

•Tablet Composition: Sticky ingredients in the formulation contribute to increased adhesion, making the tablets more prone to sticking.

•Tooling Selection: Improper selection of punch and die materials and coatings.

•Process Parameters: High press speeds and compression forces can further elevate the risk of sticking.

•Environmental Conditions: The presence of moisture in the manufacturing environment can increase sticking.

Polymer inserts offer an affordable solution.

Whilst these are some of the most common factors, there's many more, so if you're unsure, it's best to contact your tooling supplier. To effectively minimise sticking, manufacturers must employ strategic solutions, for example, implementing specialised non-stick coatings on punch and die surfaces creates a protective barrier. This prevents direct contact between the tablet granules and the tooling, effectively reducing sticking. When used with high-quality tooling steel, they allow for better tabletting efficiency and output by reducing the requirement for tools to be taken out of production for additional cleaning. In the past, we've recommended PharmaCote EC^{xtra} and PharmaCote CX for our customers compressing effervescent tablets.

It is important to understand that due to the unique physical properties of each sticky formulation, there is no one-size-fits-all anti-stick solution. Another important consideration is ensuring the control of production variables. Monitoring and controlling factors such as press speed, dwell time, and compression force are essential. These measures allow manufacturers to minimise the risks associated with sticking. In the case of formulations with more time dependant consolidation behaviour like many effervescent, a long dwell time is important. Extended dwell time at main compression is more important for formulations with predominantly elastic deformation behaviour rather than brittle fracture behaviour. In a situation whereby a greater dwell period may be required, extended dwell flat tooling (XDF) will enable a suitable compression dwell time for a formulation without the disadvantage of slowing the press.

By thoroughly understanding the root causes behind sticking issues and implementing proven techniques, manufacturers can successfully overcome sticking challenges in effervescent tablet compression. As a result, tablet production becomes more consistent, efficient and ensures

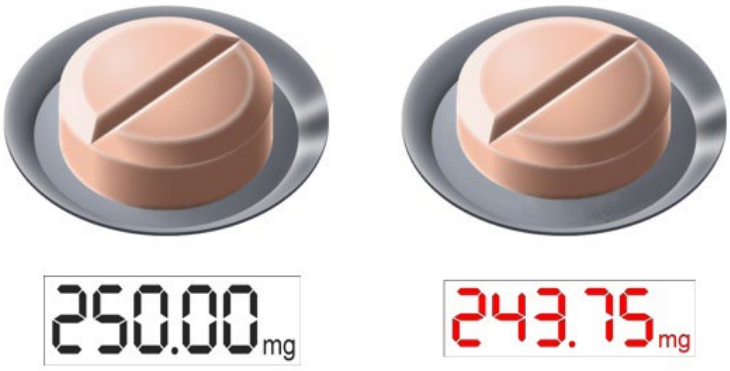
the delivery of high-quality products to consumers.

Sticking isn't the only issue faced, however. The abrasive nature of certain ingredients found in effervescent tablets, particularly those containing acidic or alkaline components, can lead to tool wear, adversely affecting tablet quality and production efficiency. Opting for tooling materials with high wear resistance, such as hardened steel, carbide, or a coated tool, can significantly prolong tool life and minimise the impact of abrasion. When choosing a tool material, if able to, it is helpful to share your formula with your tooling supplier, who will be able to use their experience to recommend a suitable material. Careful consideration should be given to the specific tablet formulation and its potential abrasive characteristics.

In the seemingly unending list of considerations to be made while producing tablets, achieving precise dosage control and consistent tablet weight is paramount in producing effervescent tablets. Tablet weight variations can arise from formulation inconsistencies, inadequate powder flow, and insufficient compression forces. Tackling this challenge requires attention to critical aspects of the manufacturing process. Careful formulation optimisation and ingredient selection play a pivotal role in reducing variations in powder flow and improving tablet weight uniformity. Rigorous testing and fine-tuning are essential to attain optimal tablet characteristics. Ensuring the appropriate compression force during tablet formation is also critical to achieving consistent tablet weight. Adjusting press parameters, such as dwell time and compression force, allows for better control and stability, minimising weight variations.

Sticking is a commonly seen production issue

Coating properties can alleviate production issues



It is vital tablet weight stays consistent for dosage