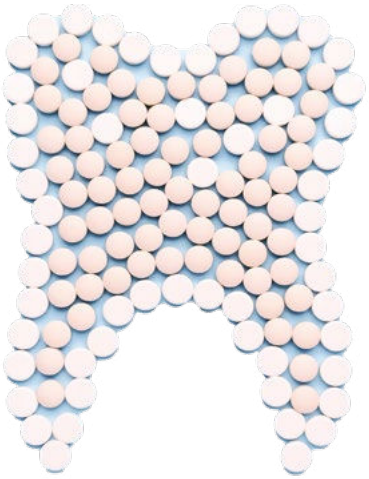

Unique tablets require unique solutions - read on!

Chew on This: Smarter Solutions for Toothpaste Tablet Production

Dental hygiene is a vital part of cleanliness, a fact which has been known since about 5000 BC, when ancient Egyptians were using pastes to keep their teeth clean. Whilst these pastes, and even rudimentary toothbrushes, existed all over the ancient world, they differ from what we currently use, with the tooth 'pastes' being powders that were applied to the teeth. Modern iterations of toothpastes like we use now were developed in the 1850's. Since then, not much has changed in how we brush our teeth, although most toothpastes you will find now have similar formulations, they typically contain three main components: abrasives, fluoride, and detergent. In more recent times however, chewable toothpastes have been introduced to the market as a convenient alternative to teeth brushing. Chewable toothpaste can be transported easily when traveling, and offer a sustainable solution to eliminating the plastic tubes traditional toothpastes come in.

These chewable toothpastes are also sometimes known as 'tab' or 'tablet' toothpastes and like any other tablet you might produce, they require compression into a solid form. Similarly, as with any tablet, issues during production are likely to arise, with common complaints for this product being abrasion, sticking and capping and lamination.

Abrasives are important for removing plaque from teeth and can constitute 8-20% of the formulation. Removal of plaque is vital to avoid build-up of tartar and avoiding gum disease. Whilst abrasives are key to keeping teeth clean, they are, of course, not particularly friendly to your tooling. The area of tooling you will likely observe this abrasion affecting first may be the tip. Tip wear and abrasion is the result of frictional forces, as the granule being compressed is forced across the tip face. Abrasion usually appears as a series of scratches or striations on the tool surface. You may also observe abrasion in the form of pitting, which is a deterioration of the punch face caused by the impregnation from the granule being compressed. This can happen faster if compressing hard or sharp granules. With that noted, abrasion can lead to some unwanted effects which result in poor tablet quality.

Problem 1: Abrasion leads to sticking

One such example occurred when a customer manufacturing chewable toothpaste tablets contacted I Holland to ask for our expertise. They were experiencing sticking using a competitor's tooling. Upon investigation, we discovered that the sticking did not occur from the outset but rather after a short period of use. This, along with visual assessment of the tip faces, resulted in the conclusion that the sticking was occurring due to abrasion. As the formulation was clearly abrasive and had some sticking characteristics, we opted for a coating in our range that has excellent abrasion resistance (2000Hv) as well as excellent anti-stick properties – I Holland PharmaCote CN. After introducing the new coating, the tools ran for a much longer amount of time with no issues of abrasion or sticking, resulting in the production of perfect toothpaste tablets. The customer

was pleased and increased their tablet output resolving both the abrasion and sticking issues and increasing the usable life of the tool.

The Science Behind Sticking

To solve sticking, an understanding of the underlying science and root cause is essential. When compressing powders into tablets, cohesive and adhesive forces are at work. Cohesive forces hold a tablet together and are mainly affected by three elements: Van der Waals forces, capillary action, and electrostatic forces. Simply put, Van der Waals forces are attractive forces between molecules. They act over a short range but, in mass, combine to increase the cohesive force within a tablet. Capillary action can be linked to tablet formulations with high moisture content and is generated when moisture condenses in the gap between particles or between a particle and a surface. Static electricity is a major cause of sticking and often occurs when tableting dry granules. The resulting force can be relatively strong, with the potential to create both cohesive and adhesive forces.

Adhesive forces cause tablets to stick to the punch faces after compression. It is affected by the surrounding environment, and the chemistry between the formulation and the punch. The environment around the tableting process and even around the formulation preparation process are critical. Temperature has a huge influence on some ingredients. If one of the ingredients in your chewable toothpaste is especially sensitive to temperature, lowering the temperature in the tableting area can help reduce sticking during compaction. When adhesive forces are stronger than the cohesive forces, sticking occurs. Once the root cause has been identified, to effectively minimise sticking, tablet manufacturers must employ strategic solutions and consider coating and material selection. As there are many factors to consider when choosing a coating, it can feel overwhelming and that's why it is recommended, if possible, to share properties of your formulation with your reputable tooling supplier and take advantage of their knowledge. This will guide you to the correct choice, first-time round.

Sticking produces poor tablets with varied weights

Problem 2: Capping and Lamination

Another common problem when compressing chewable toothpastes is capping and delamination. This is the laminar separation of the tablet body or cup and can occur during tablet compaction or any other processes up to and during the packaging phase.

I Holland once helped a customer who was compressing toothpaste tablets and suffering with an issue of capping. To combat the issue, we introduced a die taper. A die taper is a tapered opening at the top of the die and typically goes to a depth of 5mm. It assists in air evacuation and ejection of the tablet and removes the risk of air entrapment, a common cause of capping.

After the introduction of the taper, the customer started producing tablets with no de-

Air entrapment can cause capping to occur

fects. The solution saved time and resources inspecting and removing the defective tablets. Being a very manual process for the customer, and due to the original number of defects, this time saving was significant. There was also an additional cost saving as their waste was reduced and their tabletting yield was increased.

If not using a tapered die, there are other methods for ensuring there is no air entrapment within the body of the tablet. This includes compressing the tablet higher in the die, having sufficient clearance between the upper punch and the die bore that allows air to escape which assists with the ejection of the tablet by reducing the frictional forces as the tablet travels up through the die bore to ejection and helps remove air release from the compression zone during compression. If possible, it's also good practice to use pre-compression to remove air prior to full compression or reduce press speed to allow time for the air to escape. Alternatively, implementing an XDF (extended dwell flat) punch head to allow an increase in dwell time achieves the same effect without needing to sacrifice efficiency by slowing down the press. In addition, tablet and tooling design should be a consideration if you are struggling with capping and lamination. In some cases, reducing the cup depth of punches may alleviate the issue. In all cases, consult with your tooling supplier to determine the best solution for your situation.

Overall, manufacturing chewable toothpaste tablets presents unique challenges, but with the right tools, techniques, and guidance, these can be effectively addressed. Partnering with experts like I Holland ensures you can produce high-quality tablets while optimising efficiency.

CN coating offers superb anti-stick qualities

Die tapers provide air with a route to escape

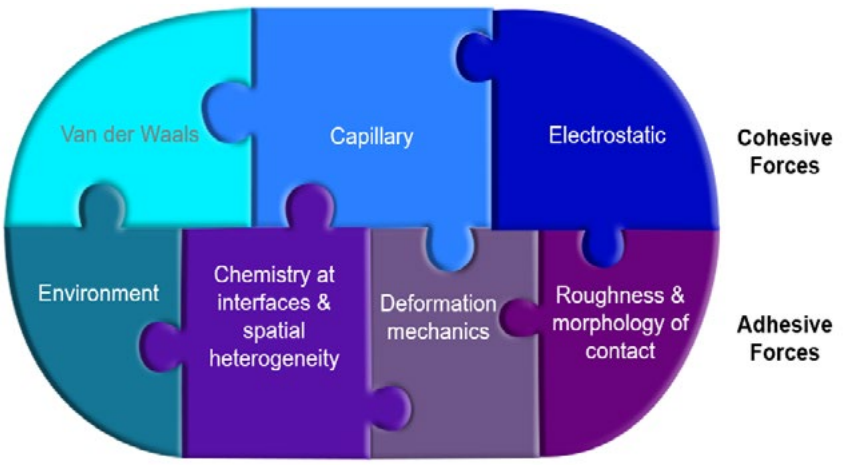

Diagram showing factors contributing to sticking