Tablet Weight Variation -- Poorly flowing particles in the formulation

What is meant by "flow" of particles in a granular formulation?

In a tablet press, the particles in a granular formulation must travel/flow from the storage hopper to the Fill-O-matic feeder and then to the die cavity. Sticky cohesive particles do not flow readily as indicated by the Repose angle. Tablet weight variations can be caused by poor flow characteristics of the particles.

KEY TIPS

The better the flow characteristics the less mechanical force is needed to process; and vice versa.

Granulation of the formulation: 1. Improves flowability, 2. Improves compressibility, 3. Ensures content uniformity of the Active Pharmaceutical Ingredient (API).

PROBLEM

Poor flow characteristics of the granulation.

Cause & Solution

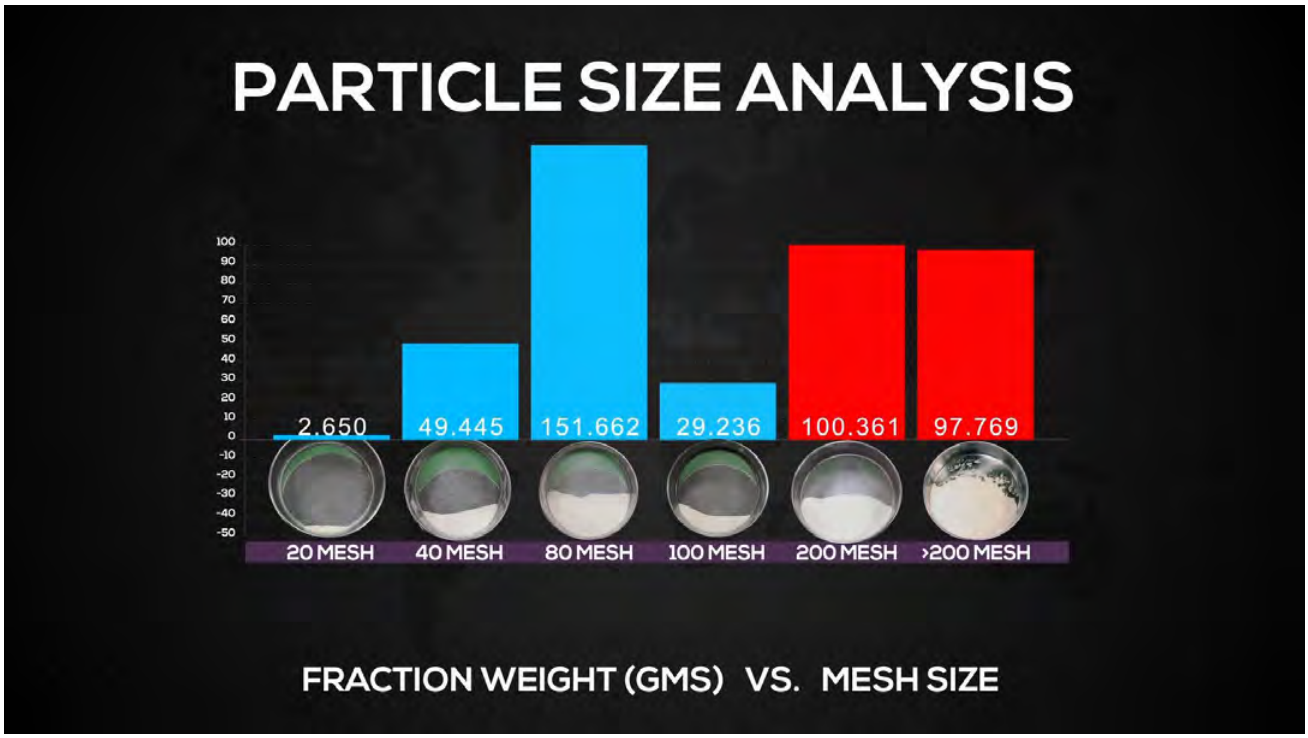
Re-agglomeration of particles -- that is, dry granulation by compaction and milling; or wet granulation process with suitable binder will improve flow characteristics.

Tablet Weight Variation -- Too many fine particles in formulation

What is meant by "fine particles"?

Fine particles are considered to be in the size range above 200 mesh. The presence of some "fines" will impart aesthetic appearance to the tablet and granulations usually contain less than 20% "fines" for best performance. Too many "fines" will impede the flow, reduce yields, affect content uniformity, cause advanced wear on tooling and lower the tablet hardness.

Learn more -- Watch video -- Effect of Fines.mp4



KEY TIPS

Fine particles contribute to hardness and flow issues, tablet lamination, etc. Screening the granulation to separate fines prior to the tableting process will reduce the fraction weight of fine particles in a given granulation batch.
Also, dry or wet granulation process builds the fine particles to a larger size. Then milling the resulting agglomeration will control the particle growth.

PROBLEM

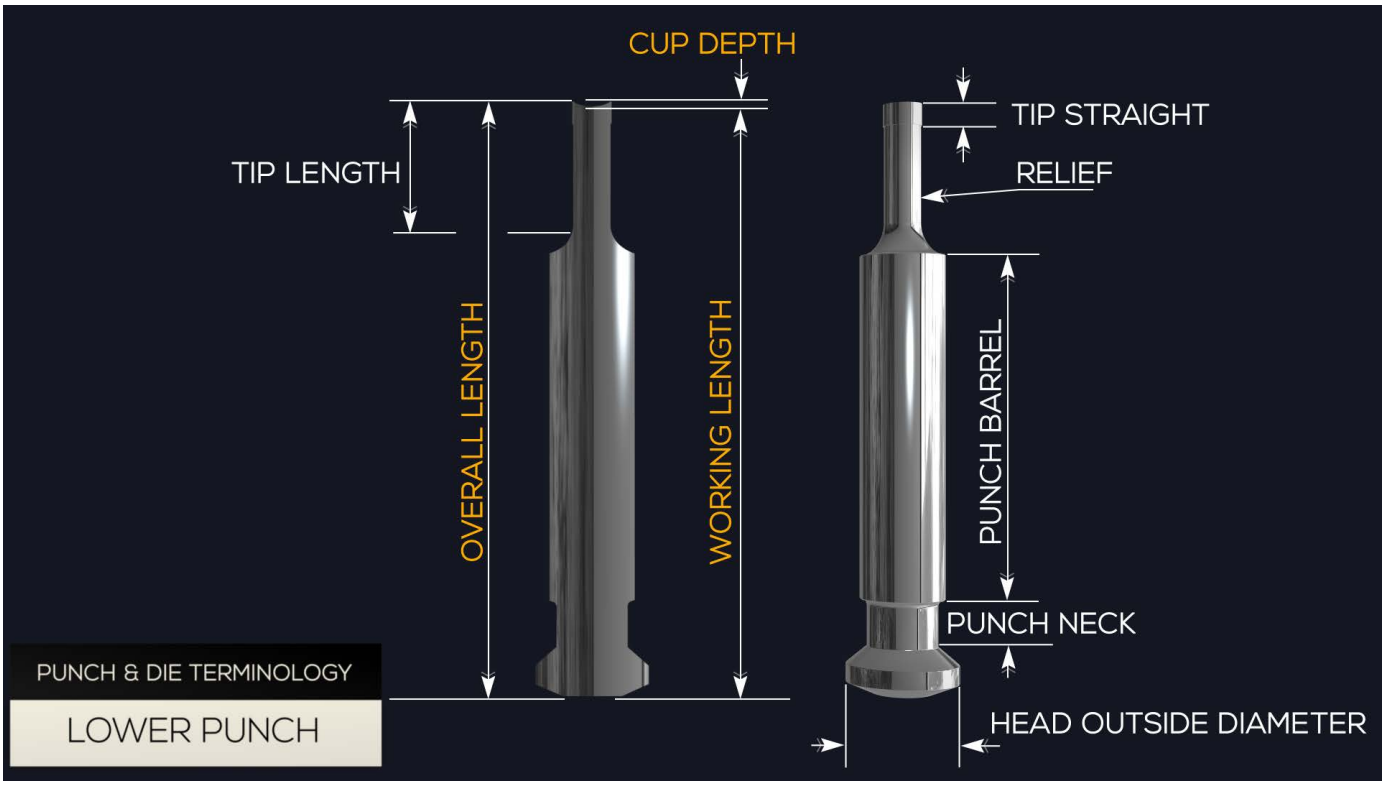
Too high percentage of fine particles in granulation

Cause & Solution

1. Screen the fine particles from the formulation.
2. Apply dry or wet granulation process depending on the formulation ingredient properties.

Tablet Weight Variation -- Working length out of specification

What is the Working length?
The Working length is the distance between the head flat and the center of the cup depth. It is primarily responsible for the final tablet thickness, hardness and weight. Therefore, the major concern is to maintain consistency within a set of lower & upper punches.



KEY TIPS

The most critical dimension is the Working Length.
The variation within a complete set of Upper or Lower punches should not exceed a range of 0.002" [0.05] Total Indicator reading.

Problem

Working length out of specification

Cause & Solution

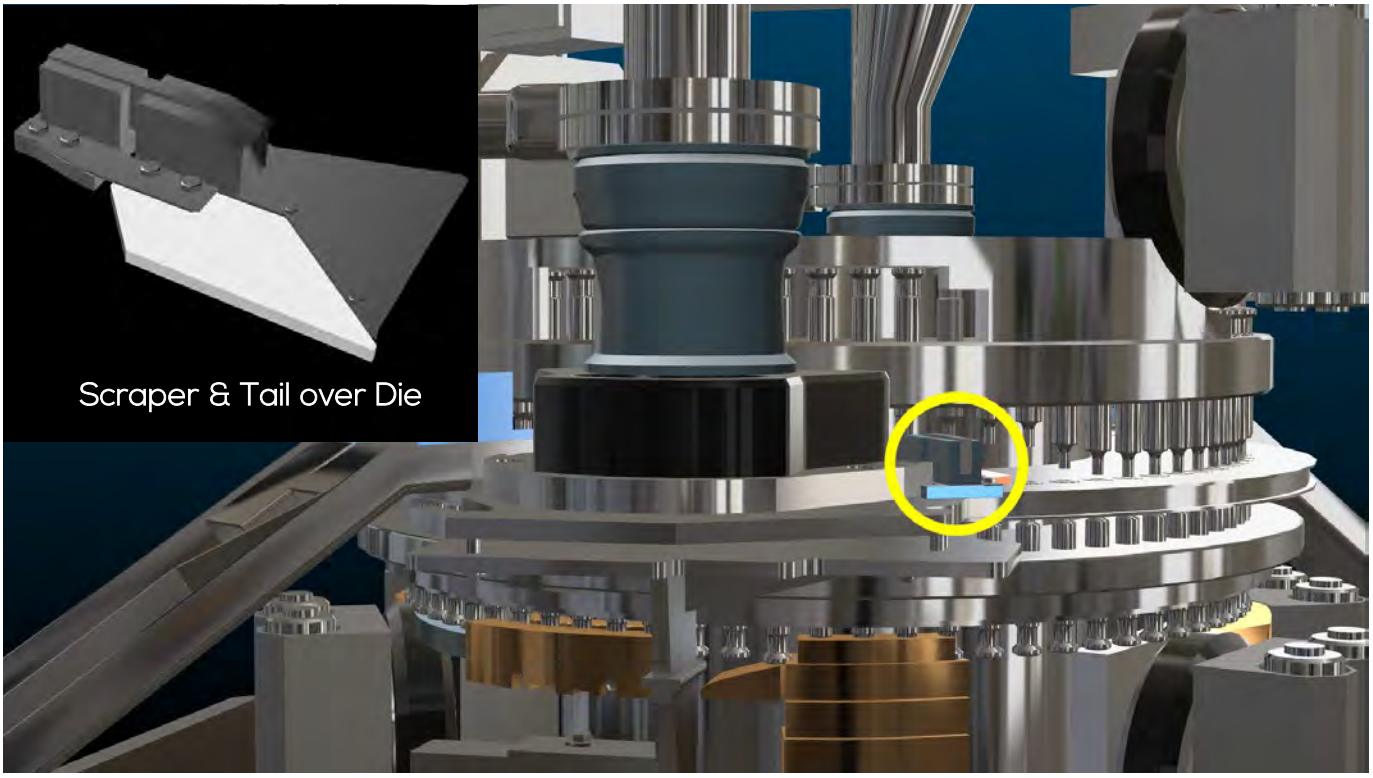
1. Replace out-of-spec punches.
2. Establish program to check tooling parameters at regular frequencies.
3. Store punches properly in approved design storage compartments.

Tablet Weight Variation -- Damaged Scraper blade & Tail over Die

What is the Tail over Die?

Also attached to the scraper is the "Tail over Die" mechanism. It is that flat nylon plate that rides on the turret die table surface. Its purpose is as follows:

- Covers metered dose inside dies.
- Extends from end of feeder until Pre-compression.
- Designed to prevent granulation from slinging at high speeds.



KEY TIPS:

Examine the Die table after the Scraper blade. Observe if granulation is leaking from under the scraper blade.

Granulation appearing on the Die table after the Scraper blade means worn/damaged blades or springs.

PROBLEM

1. Damaged or worn Scraper Blade.
2. Improperly installed Tail over Die.

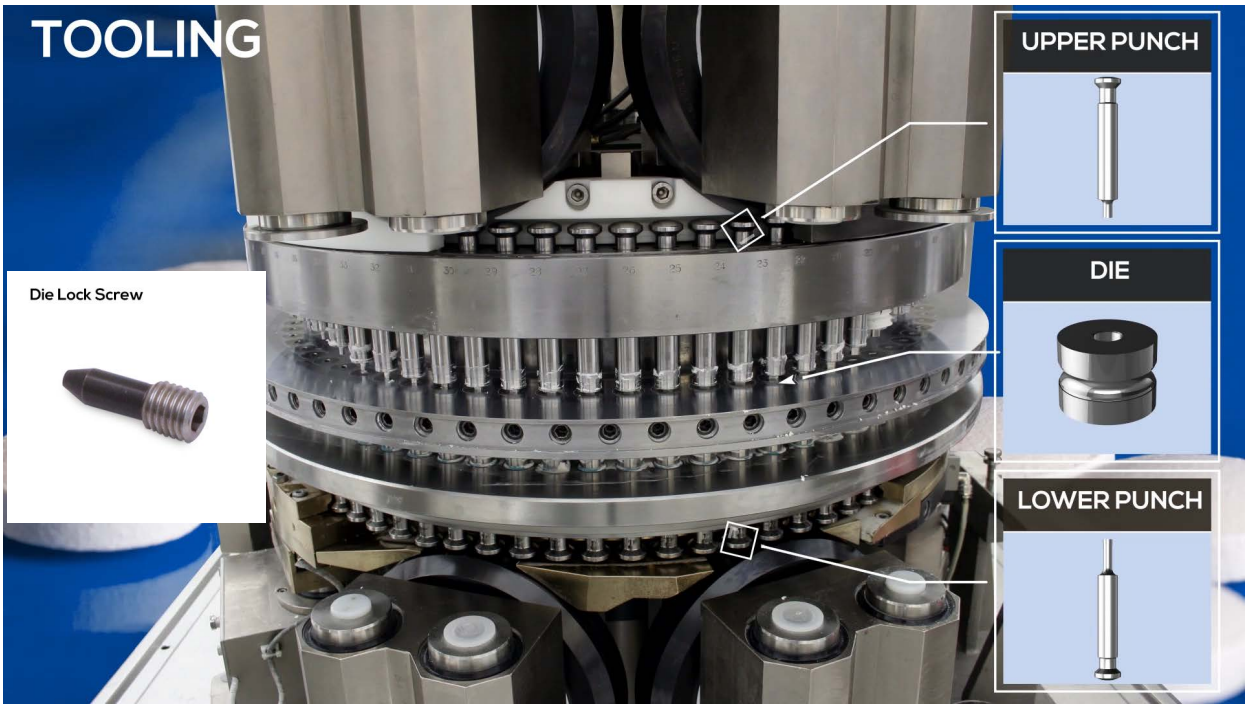
Cause & Solution

1. Remove the Scraper & Tail over Die .
2. Replace both blade and springs with new.
3. If the scraper blade is not flush to the die table, it can lead to burn marks.
4. Tail over die must sit flush on die table.

Tablet Weight Variation -- Die Seating

What is the Die?
As shown in diagram below, the Die is the tool that serves as a mold in which the granulation is compressed to form the desired profile of a tablet.

Learn more -- Watch video -- Dies.mp4



KEY TIPS: These are necessary tools for proper die installation.

Die driving rods with replaceable composite tips


Die Insertion Ring


Die Seat Cleaning Tool


Die Bore Cleaning Brushes


Torque Wrench


Die lock T-handle wrench

Dies are not seated properly. Dies should be installed flush with the die table surface.

PROBLEM

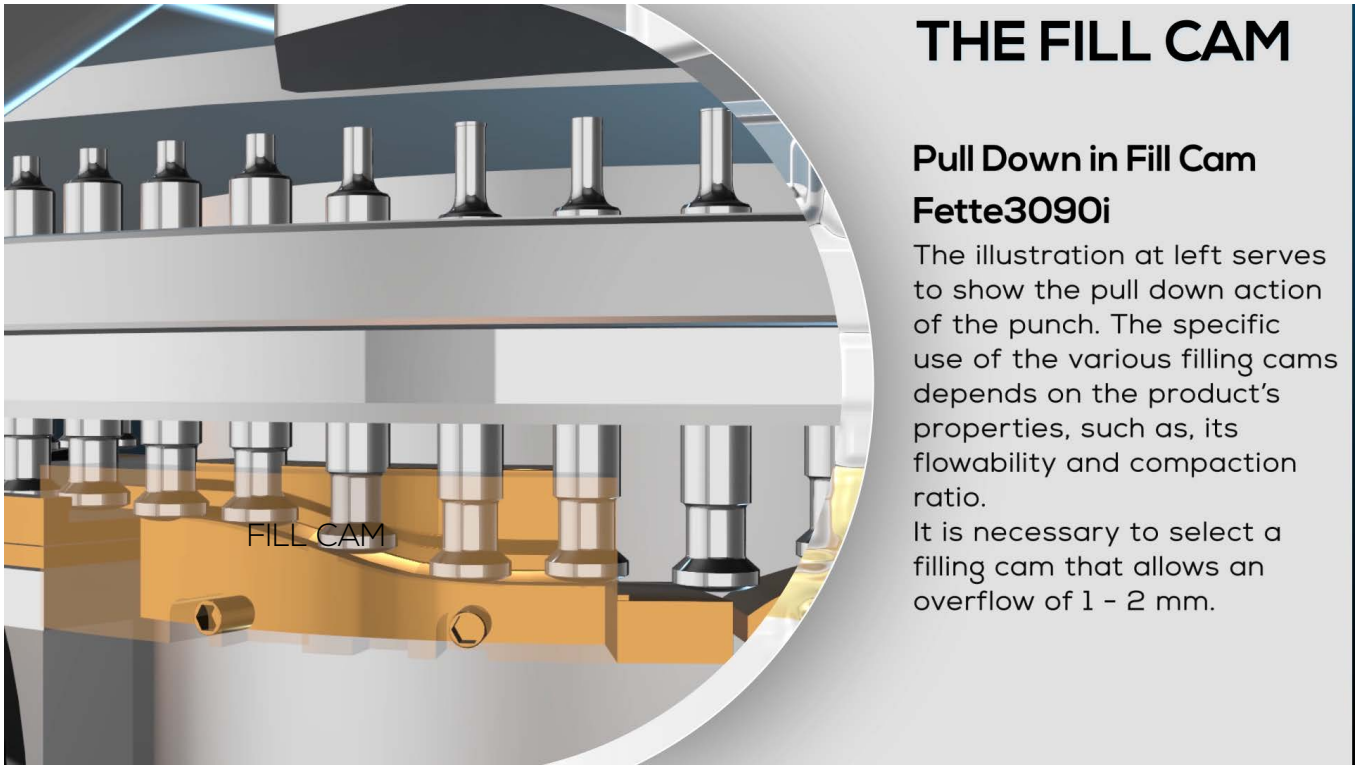
1. Clean die pockets with Die Seat Cleaner tool before installing dies.
2. Ensure vertical alignment of dies during die insertion by using Die Insertion Ring.
3. Clean & lubricate (food grade) die lock screws. Apply with die lock T-handle wrench. Then lock with torque wrench. Torque Specification = 10 - 12 Nm.

Cause & Solution

Tablet Weight Variation -- Incorrect Fill cam (Parameter 39)

What is the Fill cam?
As shown in diagram below, the fill cam pulls the lower punches downward in order to allow granulation to enter the die bore. It is located below the Fill-O-matic granulation feeder.

Learn more -- Watch video -- Filling Cam.mp4



KEY TIPS:

Target Fill Depth (Equation #1) = $\frac{\text{Actual Fill depth(mm) X Target Weight (mg)}}{\text{Actual Tablet Weight (mg)}}$

Fill Cam size Selection (from Parameter 39) = (Thickness of tablet x 2) + 2

INCORRECT FILL CAM

PROBLEM

Verify the actual filling depth (Parameter 6) is less than 80% of the actual fill cam (Parameter 39).

Let us look at an example:

From Parameter 6, Actual Fill depth = 5.00 mm
From Parameter 39, Actual Fill cam = 6.00 mm
From Design specs,Tablet Target Weight = 300 mg
Actual tablet weight (obtained from sample run)= 260 mg
From equation #1, the Target Fill Depth = 5.77

Result:

Target Fill Depth › 80% of Actual Fill cam -- (5.77 › 4.80)
Need to change the Fill Cam to the next size up = 8mm

Cause & Solution

Tablet Weight Variation -- The Dosing Cam -- Loose or worn Ledge Cam

What is the Dosing or Weight Adjustment cam?
Right after the Fill cam is the Dosing cam. It raises the lower punch in order to push excess powder out of the filled die. It adjusts the volume of Granulation in the Die by moving up or down slightly to maintain tablet weights. Remember the Fill cam causes an excess of the required filled powder by 2 mm into the die.

Learn more -- Watch video -- Dosing Cam.mp4

KEY TIPS
The inner and outer ledge cams hold the lower punch in place at the final filling of the Die. Ensuring these cams are free from wear is critical so that lower punches are not subjected to looseness or vibration.

The Dosing Cam
Loose or worn Ledge Cam

PROBLEM

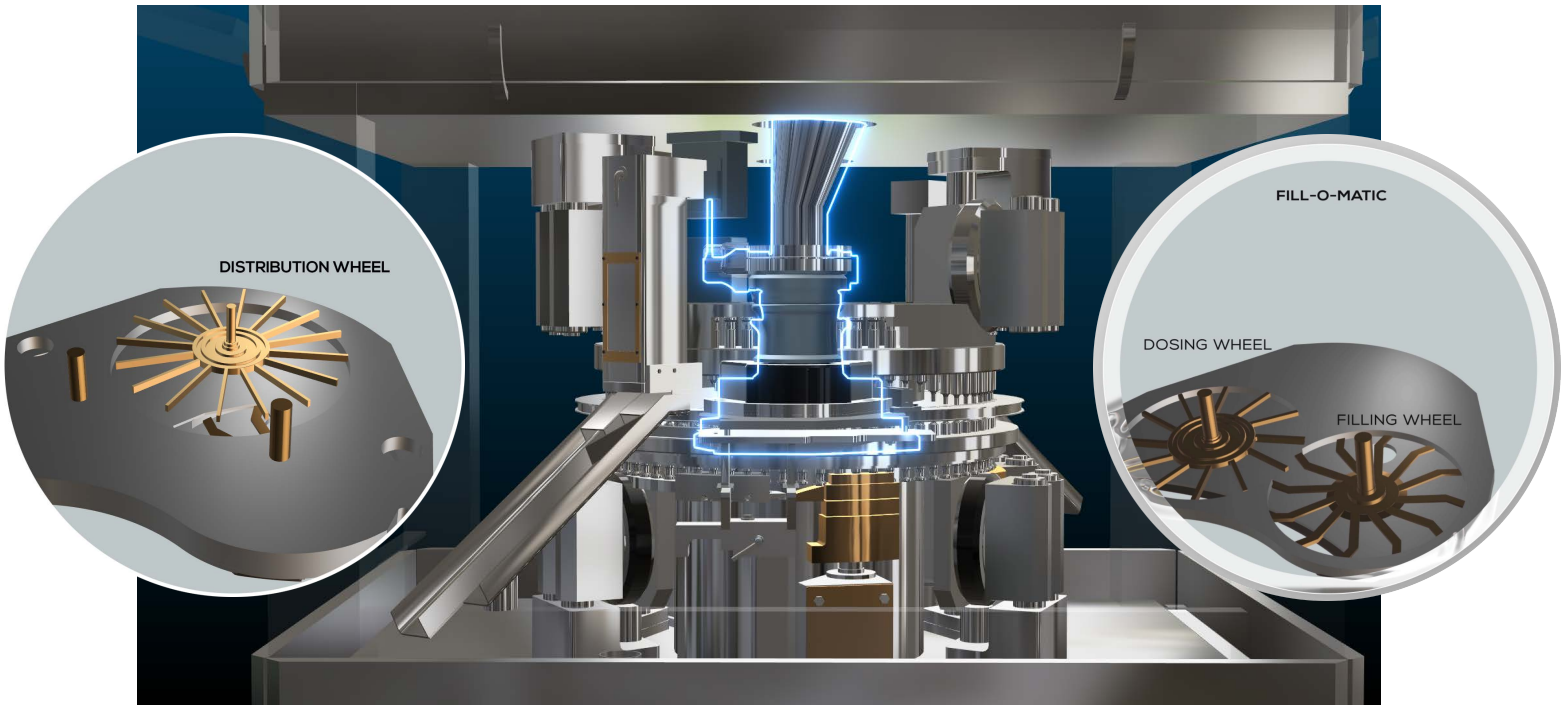
1. Check pull down area of the inner ledge cam for wear.
2. Replace the inner ledge cam in order to correct granulation loss from over filling at pre compression station.
3. Run the press and check for bolt looseness; tighten both inner and outer ledge cams.

CAUSE & SOLUTION

Tablet Weight Variation -- Fill-O-Matic does not feed granulation efficiently

What is the Fill-O-Matic ?
The Fill-O-Matic directs granulation to the dies.
It uses the three-chamber system -- 1. The Dosing Wheel, 2. Filling Wheel and 3. The Distribution wheel. The Upper chamber contains the Distribution wheel and the two lower chambers contain the Dosing and Filling wheel. Paddle wheel performance can be optimized for a specific granulation by changing the paddle wheel profile.

Learn more -- *Watch video -- Fill-O-Matic.mp4*



KEY TIPS
In some cases, better performance is obtained with round paddle profile.
Install the Fill-O-Matic on the highest plane of the Die table. using a level gauge, ensure Fill-O-matic is level.
Preventive Maintenance procedures should include: 1. Check for wear in base-plate,
2. Check seals of paddle wheel shafts, 3. Check if paddle wheels are warped and binding.

Inadequate granulation feed

PROBLEM

1. Increase/decrease speed; observe impact on *Parameter 8* -- Main compression force SREL. The lower the SREL value the better the filling of the dies.
2. Check Hopper restriction valve setting.
3. Check granulation flow properties.
4. Check that the Fill-O-matic is installed correctly -- 0.005" above die table.

CAUSE & SOLUTION