EQUIPMENT QUALIFICATION AND VALIDATION OF TABLET COMPRESSION MACHINE


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ABSTRACT

Qualification an ideal step for equipment validation is the action undertaken to demonstrate the intended use and performance of the utilities and equipment. The individual steps of qualification such as design, installation, operational and performance qualification were done in order to qualify the equipment. Blue print of equipment validation was also included. In this article the compression parameters such as compression force, turret rpm and feeder rpm were studied. The process capability of the equipment was studied by observing the weight of 20 tablets, disintegration time, friability, individual weight variation, thickness and hardness. These parameters were studied at three different speeds and the best results were obtained at the optimum speed (40 rpm).

KEYWORDS: Qualification, validation, design, installation, operational, performance, compression

INTRODUCTION

Qualification: It refers to activities undertaken to demonstrate that utilities and equipment are suitable for their intended use and perform properly. The individual qualification steps are defined as follow:

Design Qualification (DQ): It is the documented verification that the proposed design of the facilities, systems and equipment is suitable for the intended purpose.
Installation Qualification (IQ): It is documented evidence that the premises, supporting utilities, the equipment have been built and installed in compliance with design specifications.

Operational Qualification (OQ): In this phase the process parameters are challenged to assure that product meets all defined requirements under all anticipated conditions of manufacturing, i.e., worst case testing.

Performance Qualification (PQ): The performance qualification is carried out to establish the performance and efficiency of the tablet machine during tablet compression operation. The key objective of this phase is to demonstrate that the process will produce acceptable product under normal operating conditions.

A Typical Validation Blueprint of Equipment Validation:
1. Installation qualification
   - Facilities
   - Utilities
   - Equipment
2. Operation qualification
   - Testing Protocols for Utilities and Equipment
3. Validation
   - Testing protocols for products and cleaning systems
4. Documentation
5. Validation of the QA testing laboratory
6. SOPs
7. Training of personnel
8. Organization charts, Schedule of events

The main aim and objective of this research is to qualify the equipment based on its process capability by observing the compression parameters.

METHODOLOGY

Execution of Design Qualification
- Documentation and verification of procedures required to fulfill the protocol.
- Execution of protocol and data collection, interpretation and review of data for accuracy, completeness and cGMP compliance.
- Approval of original protocol formats, approval for the final summaries and system qualification statement.
Execution of IQ, OQ and PQ:
- It includes the development and approval of an IQ, OQ, PQ protocols followed by the performance of IQ, OQ, PQ. The further step includes the workout and approval of IQ, OQ, PQ reports.

Procedure Followed for Performance Qualification:
- The blend/dummy material was unloaded into the hoppers on the both sides and the compression machine was operated at low speed (20RPM) as per operating instructions. Then the machine was set to run for 20 minutes continuously after adjusting the following parameters.
  1. Individual tablet weight variation
  2. Weight of 20 tablets
  3. Hardness
  4. Thickness
  5. Disintegration time, Friability

- Then the experiment was repeated at both medium (40RPM) and high speed (60RPM) with same set of parameters and the parameters were checked at different speeds (low, medium and high rpm). The results were reported.

   Sampling Plan
- Collect 100 tablets for every 05 minutes.

RESULTS & DISCUSSION

TABLE No. 1:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>PARAMETER</th>
<th>ACCEPTANCE CRITERIA</th>
<th>TIME INTERVAL (LHS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Weight of 20 tablets</td>
<td>21.28 ± 2% (20.85 – 21.71g)</td>
<td>21.24</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>21.26</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>21.26</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>21.28</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>21.25</td>
</tr>
<tr>
<td>2</td>
<td>Disintegration Time</td>
<td>NMT 20 min</td>
<td>10'52&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12'31&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>09'59&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11'02&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12'15&quot;</td>
</tr>
<tr>
<td>3</td>
<td>Friability</td>
<td>NMT 0.8% w/w</td>
<td>0.34</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.41</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.37</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.33</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.39</td>
</tr>
</tbody>
</table>

The compression parameters such as weight of 20 tablets, disintegration time, friability, individual weight variation, thickness and hardness are taken in to consideration at slow
(20RPM), medium (40RPM) and high (60RPM) speeds of machine. The results shown here are the one observed at medium speed (40RPM) which is found to be optimum.

**TABLE No. 2**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>PARAMETER</th>
<th>ACCEPTANCE CRITERIA</th>
<th>TIME INTERVAL (RHS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 min</td>
</tr>
<tr>
<td>2</td>
<td>Disintegration Time</td>
<td>NMT 20 min</td>
<td>11'31&quot;</td>
</tr>
<tr>
<td>3</td>
<td>Friability</td>
<td>NMT 0.8% w/w</td>
<td>0.36</td>
</tr>
</tbody>
</table>

**TABLE No. 3**

<table>
<thead>
<tr>
<th>Time / No. of Tablets</th>
<th>Individual Weight Variation of the tablet : 1.064 ± 5.0% (1.011 – 1.117 g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 min LHS</td>
<td>1.061 1.060 1.057 1.067 1.070 1.059 1.059 1.062 1.059 1.059</td>
</tr>
<tr>
<td>05 min LHS</td>
<td>1.054 1.045 1.061 1.067 1.063 1.061 1.060 1.059 1.066 1.055</td>
</tr>
<tr>
<td>10 min LHS</td>
<td>1.057 1.066 1.053 1.059 1.053 1.071 1.069 1.050 1.070 1.059</td>
</tr>
<tr>
<td>15 min LHS</td>
<td>1.065 1.066 1.059 1.058 1.063 1.060 1.064 1.047 1.063 1.061</td>
</tr>
<tr>
<td>20 min LHS</td>
<td>1.042 1.049 1.056 1.056 1.060 1.051 1.064 1.056 1.059 1.056</td>
</tr>
<tr>
<td>0 min RHS</td>
<td>1.053 1.064 1.076 1.060 1.058 1.061 1.057 1.064 1.059 1.065</td>
</tr>
<tr>
<td>05 min RHS</td>
<td>1.063 1.067 1.070 1.059 1.072 1.071 1.075 1.065 1.051 1.055</td>
</tr>
<tr>
<td>10 min RHS</td>
<td>1.057 1.066 1.053 1.059 1.053 1.071 1.069 1.050 1.070 1.059</td>
</tr>
<tr>
<td>15 min RHS</td>
<td>1.054 1.064 1.063 1.058 1.055 1.063 1.059 1.057 1.075 1.059</td>
</tr>
<tr>
<td>20 min RHS</td>
<td>1.054 1.056 1.043 1.043 1.065 1.054 1.056 1.053 1.046 1.058</td>
</tr>
</tbody>
</table>

**TABLE No. 4**

<table>
<thead>
<tr>
<th>Time / No. of Tablets</th>
<th>Thickness: 7.1 ± 0.3mm (6.8 – 7.4mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 min LHS</td>
<td>6.98 6.96 6.98 6.97 6.94 6.94 6.93 6.93 6.90 6.92</td>
</tr>
<tr>
<td>05 min LHS</td>
<td>6.98 6.94 6.96 6.98 6.97 6.84 6.86 6.89 6.86 6.92</td>
</tr>
<tr>
<td>10 min LHS</td>
<td>6.94 6.98 6.94 6.98 6.97 6.88 6.89 6.93 6.97 6.87</td>
</tr>
<tr>
<td>15 min LHS</td>
<td>6.94 6.92 6.94 6.94 6.97 7.01 7.0 6.98 6.99 6.94</td>
</tr>
<tr>
<td>0 min RHS</td>
<td>6.96 6.94 6.98 6.93 6.94 6.98 7.01 6.96 6.96 6.96</td>
</tr>
<tr>
<td>05 min RHS</td>
<td>6.89 6.97 6.98 6.94 6.87 6.94 6.93 6.94 6.93 7.00</td>
</tr>
<tr>
<td>10 min RHS</td>
<td>6.89 6.96 6.98 6.94 6.89 7.0 6.96 7.01 7.0 6.98</td>
</tr>
<tr>
<td>15 min RHS</td>
<td>6.89 6.89 6.94 6.95 6.98 6.93 6.94 6.98 6.98 6.94</td>
</tr>
<tr>
<td>20 min RHS</td>
<td>6.89 6.96 6.98 6.94 6.89 7.0 6.96 7.01 7.0 6.98</td>
</tr>
</tbody>
</table>
TABLE No. 5

<table>
<thead>
<tr>
<th>Time / No. of Tablets</th>
<th>Hardness: 10.0 - 16.0 kp</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>0 min</td>
<td>LHS</td>
</tr>
<tr>
<td></td>
<td>RHS</td>
</tr>
<tr>
<td>05 min</td>
<td>LHS</td>
</tr>
<tr>
<td></td>
<td>RHS</td>
</tr>
<tr>
<td>10 min</td>
<td>LHS</td>
</tr>
<tr>
<td></td>
<td>RHS</td>
</tr>
<tr>
<td>15 min</td>
<td>LHS</td>
</tr>
<tr>
<td></td>
<td>RHS</td>
</tr>
<tr>
<td>20 min</td>
<td>LHS</td>
</tr>
<tr>
<td></td>
<td>RHS</td>
</tr>
</tbody>
</table>

SUMMARY & CONCLUSION

The parameters studied under the compression process are such as compression force, turret rpm and feeder rpm. These are set at three different speeds and analyzed on both sides to assess the exact parameters.

Turret was set at the speed of 20rpm with Feeder at LHS as 32rpm, at RHS as 36rpm and Compression Force (KN) Main at LHS as 17.0, at RHS as 16.1 and Pre at LHS as 5.7, at RHS as 5.3.

Turret was set at the speed of 40rpm with Feeder at LHS as 52rpm, at RHS as 56rpm and Compression Force (KN) Main at LHS as 16.9, at RHS as 17.1 and Pre at LHS as 5.7, at RHS as 6.2.

Turret was set at the speed of 60rpm with Feeder at LHS as 70rpm, at RHS as 75rpm and Compression Force (KN) Main at LHS as 15.8, at RHS as 16.3 and Pre at LHS as 5.6, at RHS as 6.5.

The samples were collected from both the sides (LHS, RHS) to qualify the two press stations and the observations made from the results were found to be in specified limits as per the IH specifications.

From this we conclude that the equipment is successfully qualified and can be used for production of further batches.
ACKNOWLEDGMENT

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REFERENCES


