Effect of Weight Stabilization before Curing of V-Belt
Abdul Kalam Azad John Mohamed
Jubail Industrial College, P.O. Box: 10099, Jubail Industrial City–31961, Kingdom of Saudi Arabia

DOI: 10.36348/sjet.2020.v05i05.002 | Received: 06.04.2020 | Accepted: 24.04.2020 | Published: 07.05.2020

*Corresponding author: Abdul Kalam Azad John Mohamed

Abstract

The aim of this method is to reduce the rejection rate in V-belt using weight stabilization method. Low Belt, Double Jacket, Topping Air, and Base Air are the major rejection in V-belt due to the dissimilar weight in V-belt as the weight plays a vital role in determining the quality of a product and processing parameter such as pressure and heat. The above problems can be rectified by taking weight during the final processing stage of V-belt subsequently it can be segregated depending upon the weight range before curing and then set the curing parameters. Another aspect of taking correct weight every time for the same length & cross section of belt is the regularity of dimension. I vehemently envisage that this method can be used to reduce the rejection rate based on dissimilar weight for any rubber based products not only the V-belt. The benefits of this method is extended below
- Sophisticated device are not required to implement this method.
- Products having uneven weight can be converted into defect free product.
- Rejection rate can be firmly controlled.

Keywords: V-belt; Weigh; Stabilization; Curing.

Copyright @ 2020: This is an open-access article distributed under the terms of the Creative Commons Attribution license which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use (NonCommercial, or CC-BY-NC) provided the original author and source are credited.

METHOD

Fish bone diagram as shown in the figure 1 has been used as a preliminary tool [1] to find out the various causes for dissimilar weight in V-belt which leads to higher rejection rate by dint of insufficient quality and in order to reduce this rejection rate a new method has been established to stabilize the weight as mentioned below in the following steps.

Equipment
- Weighing machine
- Horizontal roto curing drum
- Vernier caliper
Record the weight of V-belt

Take the weight of raw belt before flipping as well as after flipping as it is a process of wrapping the raw belt for further defending the internal composition of V-belt. Thereafter, take the weight after the curing process in terms of gram per inch for the cluster of V-belt.

Segregate the V-belt

Segregate the belt for its next curing stage according to the maximum and minimum value of weight and then set the tolerance value.

Curing

Set the temperature & pressure in a horizontal roto curing drum according to its specification and weight range as higher pressure is needed to apply for low weight belt and lower pressure for belt having more weight.

Inspection

After completion of curing and cooling process, measure the dimension of cured V-belt with the help of Vernier caliper and inspect the quality of V-belt to separate the defect products.

When over viewing and going through the various studies conducted, it has been observed that the rejection rate was reduced from 0.6% to 0.3% by avoiding Base Air, Topping Air, Double Jacket, and nearly zero rejection in Low belt through this weight stabilization method together with the production feasibility as shown in the figure 2.

![Fish bone diagram](image)

Fig-1: Fish bone diagram

![Comparison of rejection rate before and after stabilizing the weight](image)

Fig-2: Comparison of rejection rate before and after stabilizing the weight
Method Validation
In order to validate this method, 15 batches of V-belt have been taken into an account as presented below.

Batch-1:
Segregation of belt: +30 gram & -30 gram
Pressure between drum & wire pad
For +30: 700 psi
For -30: 730 psi
Drum rotation: 660 rpm

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Average</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before flipping (g)</td>
<td>5.565</td>
<td>5.681</td>
<td>5.451</td>
<td>0.231</td>
</tr>
<tr>
<td>After flipping (g)</td>
<td>7.391</td>
<td>7.505</td>
<td>7.253</td>
<td>0.253</td>
</tr>
<tr>
<td>After curing (g)</td>
<td>334.0</td>
<td>0.36</td>
<td>0.304</td>
<td>0.056</td>
</tr>
</tbody>
</table>

Result:
Total: 17
Ok: 17
Rejection: nil
Reason: proper pressure has been given to this batch according to the weight.

Batch-2:
Segregation of belt: +70 gram & -70 gram
Pressure between drum & wire pad
For +70: 700 psi
For -70: 740 psi
Drum rotation: 660 rpm

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Average</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before flipping (g)</td>
<td>6.159</td>
<td>6.363</td>
<td>5.887</td>
<td>0.476</td>
</tr>
<tr>
<td>After flipping (g)</td>
<td>7.922</td>
<td>8.218</td>
<td>7.613</td>
<td>0.605</td>
</tr>
<tr>
<td>After curing (g)</td>
<td>433.75</td>
<td>546</td>
<td>318</td>
<td>228</td>
</tr>
</tbody>
</table>

Result:
Total: 17
Ok: 17
Rejection: nil
Reason: proper pressure has been given to this batch according to the weight.

Batch-3:
Segregation of belt: +40 gram & -40 gram
Pressure between drum & wire pad
For +40: 560 psi
For -40: 590 psi
Drum rotation: 540 rpm

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Average</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before flipping (g)</td>
<td>12.329</td>
<td>12.486</td>
<td>12.125</td>
<td>0.361</td>
</tr>
<tr>
<td>After flipping (g)</td>
<td>15.51</td>
<td>15.764</td>
<td>15.208</td>
<td>0.556</td>
</tr>
<tr>
<td>After curing (g)</td>
<td>408.154</td>
<td>548</td>
<td>230</td>
<td>252</td>
</tr>
</tbody>
</table>

Result:
Total: 10
Ok: 10
Rejection: nil
Reason: proper pressure has been given to this batch according to the weight.

Batch-4:
There is no need to segregate the belt, since all the belts are within the range of 40 gram.
Pressure between drum & wire pad: 730 psi
Drum rotation: 660 rpm

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Average</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before flipping (g)</td>
<td>3.367</td>
<td>3.461</td>
<td>3.199</td>
<td>0.262</td>
</tr>
<tr>
<td>After flipping (g)</td>
<td>4.508</td>
<td>4.615</td>
<td>4.411</td>
<td>0.204</td>
</tr>
<tr>
<td>After curing (g)</td>
<td>235.765</td>
<td>272</td>
<td>214</td>
<td>58</td>
</tr>
</tbody>
</table>

Result:
Total: 23
Ok: 23
Rejection: nil
Reason: All the belts are within the range of 40 gram.

Batch-5:
There is no need to segregate the belt, since all the belts are within the range of 40 gram.
Pressure between drum & wire pad: 570 psi
Drum rotation: 450 rpm
<table>
<thead>
<tr>
<th>Dimension</th>
<th>Average</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before flipping (g)</td>
<td>32.469</td>
<td>33.027</td>
<td>31.912</td>
<td>1.115</td>
</tr>
<tr>
<td>After flipping(g)</td>
<td>38.543</td>
<td>38.959</td>
<td>37.91</td>
<td>1.048</td>
</tr>
<tr>
<td>After curing (g)</td>
<td>544.714</td>
<td>584</td>
<td>472</td>
<td>112</td>
</tr>
</tbody>
</table>

**Result:**
Total : 14  
Ok : 14  
Rejection : nil  
Reason : All the belts are within the range of 40 gram.

### Batch-6:
Segregation of belt : +50 gram & -50 gram

**Pressure between drum & wire pad**
- For +50 : 550 psi  
- For -50 : 600 psi  
- Drum rotation : 600 rpm

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Average</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before flipping (g)</td>
<td>7.186</td>
<td>7.387</td>
<td>6.864</td>
<td>0.523</td>
</tr>
<tr>
<td>After flipping(g)</td>
<td>9.195</td>
<td>9.405</td>
<td>9.013</td>
<td>0.392</td>
</tr>
<tr>
<td>After curing (g)</td>
<td>491.765</td>
<td>542</td>
<td>420</td>
<td>122</td>
</tr>
</tbody>
</table>

**Result:**
Total : 17  
Ok : 16  
Rejection : (1) Jacket opening  
Reason : Improper Flipping

### Batch-7:
Segregation of belt : +70 gram & -70 gram

**Pressure between drum & wire pad**
- For +70 : 560 psi  
- For -70 : 600 psi  
- Drum rotation : 450 rpm

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Average</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before flipping (g)</td>
<td>31.826</td>
<td>32.627</td>
<td>31.03</td>
<td>1.597</td>
</tr>
<tr>
<td>After flipping(g)</td>
<td>38.14</td>
<td>38.825</td>
<td>37.354</td>
<td>1.471</td>
</tr>
<tr>
<td>After curing (g)</td>
<td>601.143</td>
<td>678</td>
<td>522</td>
<td>156</td>
</tr>
</tbody>
</table>

**Result:**
Total : 14  
Ok : 13  
Rejection : nil  
Reason : proper pressure has been given to this batch according to the weight.

### Batch-8:
Segregation of belt : +60 gram & -60 gram

**Pressure between drum & wire pad**
- For +60 : 550 psi  
- For -60 : 590 psi  
- Drum rotation : 450 rpm

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Average</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before flipping (g)</td>
<td>30.897</td>
<td>31.43</td>
<td>29.518</td>
<td>1.912</td>
</tr>
<tr>
<td>After flipping(g)</td>
<td>37.016</td>
<td>37.459</td>
<td>36.157</td>
<td>1.303</td>
</tr>
<tr>
<td>After curing (g)</td>
<td>582.571</td>
<td>696</td>
<td>450</td>
<td>246</td>
</tr>
</tbody>
</table>

**Result:**
Total : 14  
Ok : 13  
Rejection : (1) Base air  
Reason : Due to Improper Warming in the two roll mill.

### Batch-9:
There is no need to segregate the belt, since all the belts are within the range of 30 gram.

**Pressure between drum & wire pad**
- Pressure between drum & wire pad : 725 psi  
- Drum rotation : 660 rpm

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Average</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before flipping (g)</td>
<td>5.766</td>
<td>5.831</td>
<td>5.685</td>
<td>0.146</td>
</tr>
<tr>
<td>After flipping(g)</td>
<td>7.626</td>
<td>7.708</td>
<td>7.528</td>
<td>0.18</td>
</tr>
<tr>
<td>After curing (g)</td>
<td>331.125</td>
<td>352</td>
<td>316</td>
<td>36</td>
</tr>
</tbody>
</table>
Result:
Total: 17
Ok: 16
Rejection: nil
Reason: All the belts are within the range of 30 gram.

Batch-10:
Segregation of belt: +55 gram & -55 gram
Pressure between drum & wire pad:
For +55: 550 psi
For -55: 580 psi
Drum rotation: 600 rpm

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Average</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before flipping (g)</td>
<td>6.96</td>
<td>7.077</td>
<td>6.746</td>
<td>0.331</td>
</tr>
<tr>
<td>After flipping(g)</td>
<td>8.778</td>
<td>8.999</td>
<td>8.441</td>
<td>0.558</td>
</tr>
<tr>
<td>After curing (g)</td>
<td>351.882</td>
<td>408</td>
<td>290</td>
<td>118</td>
</tr>
</tbody>
</table>

Result:
Total: 17
Ok: 16
Rejection: (1) flipping mistake
Reason: Improper flipping

Batch-11:
There is no need to segregate the belt, since all the belts are within the range of 30 gram.
Pressure between drum & wire pad: 720 psi
Drum rotation: 660 rpm

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Average</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before flipping (g)</td>
<td>5.754</td>
<td>5.824</td>
<td>5.59</td>
<td>0.234</td>
</tr>
<tr>
<td>After flipping(g)</td>
<td>7.379</td>
<td>7.454</td>
<td>7.268</td>
<td>0.185</td>
</tr>
<tr>
<td>After curing (g)</td>
<td>333.125</td>
<td>364</td>
<td>298</td>
<td>66</td>
</tr>
</tbody>
</table>

Result:
Total: 17
Ok: 16
Rejection: (1) Band touch
Reason: Teared Fibre cloth is used during the curing period.

Batch-12:
There is no need to segregate the belt, since all the belts are within the range of 40 gram.
Pressure between drum & wire pad: 720 psi
Drum rotation: 660 rpm

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Average</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before flipping (g)</td>
<td>5.357</td>
<td>5.845</td>
<td>5.555</td>
<td>0.291</td>
</tr>
<tr>
<td>After flipping(g)</td>
<td>5.949</td>
<td>6.045</td>
<td>5.864</td>
<td>0.182</td>
</tr>
<tr>
<td>After curing (g)</td>
<td>48.133</td>
<td>80</td>
<td>18</td>
<td>62</td>
</tr>
</tbody>
</table>

Result:
Total: 16
Ok: 15
Rejection: (1) Band touch
Reason: Teared Fibre cloth is used during the curing period.

Batch-13:
There is no need to segregate the belt, since all the belts are within the range of 30 gram.
Pressure between drum & wire pad: 720 psi
Drum rotation: 660 rpm

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Average</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before flipping (g)</td>
<td>5.357</td>
<td>5.52</td>
<td>5.076</td>
<td>0.444</td>
</tr>
<tr>
<td>After flipping(g)</td>
<td>7.525</td>
<td>7.591</td>
<td>7.467</td>
<td>0.124</td>
</tr>
<tr>
<td>After curing (g)</td>
<td>487.882</td>
<td>542</td>
<td>460</td>
<td>82</td>
</tr>
</tbody>
</table>

Result:
Total: 17
Ok: 17
Rejection: nil
Reason: All the belts are within the range of 30 gram & proper pressure is given.

Batch-14:
Segregation of belt: +75 gram & -75 gram
Pressure between drum & wire pad:
For +75: 700 psi
For -75: 740 psi
Drum rotation: 600 rpm
### Result:
- **Total**: 17
- **Ok**: 16
- **Rejection**: (1) Double Jacket
- **Reason**: High Pressure

### Batch-15:
- **Segregation of belt**: +60 gram & -60 gram
- **Pressure between drum & wire pad**
  - For +60: 720 psi
  - For -60: 750 psi
  - Drum rotation: 540 rpm

### Result:
- **Total**: 11
- **Ok**: 11
- **Rejection**: nil
- **Reason**: Proper pressure is given to this batch according to the weight.

**ACKNOWLEDGEMENTS**

The author would like to thank everyone who have supported during this research work.

**REFERENCES**