Fortification at the Mill

Quality Assurance & Process Control at the Mill

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(with contributions from Philip Randall)
Quality Assurance Definition

A system to control all parts of the milling process to ensure the consistent production of flour that meets both regulatory and commercial requirements.

Process control of Fortification at the mill is a key component of the Quality Assurance system.
Process Control in Flour Fortification

• Flour fortification needs process controls to ensure consistent quality and safety of the output: flour adequately fortified with essential minerals and vitamins.

• Effective process control systems use mechanisms to monitor activities and take timely corrective action.

• Well implemented process control gives an early warning of problems which in turn helps to avoid wastage, reworking of product, customer complaints, food recalls and liability issues etc.
Quality Assurance Fortification
Mill Requirements and Responsibilities

• Premix procurement and storage
• Feeder/Dosifier Installation
• Feeder Calibration
• Feed Rate Calculations
• Process controls
  – Check Weighing, standards and sampling schedule
  – Iron Spot Test
• Record Keeping
• Laboratory Analysis
  – Quantitative test for Iron and Vitamins
Ultimate Process Control of Flour Fortification

- Modern mills with computer control systems
- Automatic feeder – flour scale feedback systems controlling the process
- Premix release system
- Stock Reconciliation method on weekly or monthly basis
- Iron spot test used as mill QC tool
- Good access to qualified laboratories for quantitative analysis for monitoring
Acceptable Process Control of Flour Fortification

• Manual feeder operations – volumetric type feeders
• Interlocked with either 1st Break sifter or flour collection conveyor motor
• Feeder Calibration
• Check weighing 2 – 4 times per shift
• Iron Spot Test
• Premix release system
• Stock Reconciliation method on weekly or monthly basis
• Access to outside testing laboratory
Premix Procurement and Storage

- Premix specifications or standards
- Approved supplier list at least 2 suppliers
- Purchase and storage records
- Cool dry storage room or area (A/C possible)
- Stock rotation First In First Out system
- Usage records including premix lot numbers
Feeder Placement - Gravity Feed System

Feeder is placed above flour collection conveyor.
MUST BE 3 METERS FROM DISCHARGE END OF CONVEYOR
Premix falls directly into the flour as it flows through the conveyor.
Feeder is usually placed above or near the flour collection conveyor that blends the various flour streams.
Feeder Placement Pneumatic System

Premix drops into a venturi tube, that injects the premix into an air stream.
Premix is blown by positive pressure or sucked by a vacuum through a pipe into the flour collection conveyor.
Occasionally downstream location in the flour flow can be used to add premix provided it will be well mixed with the flour.
## FEEDER SIZING AND FEED RATE CALCULATIONS

<table>
<thead>
<tr>
<th>Mill Size</th>
<th>60 MT</th>
<th>100 MT</th>
<th>200 MT</th>
<th>360 MT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flour</td>
<td>45</td>
<td>75</td>
<td>150</td>
<td>187.5</td>
</tr>
<tr>
<td>Kg/min</td>
<td>31.25</td>
<td>52.08</td>
<td>104.17</td>
<td>347</td>
</tr>
<tr>
<td>Premix</td>
<td>200 g/MT</td>
<td>200 g/MT</td>
<td>200 g/MT</td>
<td>200 g/MT</td>
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<tr>
<td>Add Rate</td>
<td>6.25 g/min</td>
<td>10.6 g/min</td>
<td>20.8 g/min</td>
<td>69.4 g/min</td>
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<tr>
<td>Premix use</td>
<td>3.0 kg/8 hr</td>
<td>5.1 kg/8 hr</td>
<td>9.9 kg/8 hr</td>
<td>33 kg/8 hr</td>
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</tbody>
</table>
Feeder Calibration

- Direct Drive Motors
- Volumetric Feeders
- Determine minimum and maximum discharge for premix
- Premix weight and volume based on density of components
Feeder Problems - Diagnosis

Premix Feeding Problems
- Bridging
- Tunneling

Flour stops, Premix keeps feeding
Feeder stops or hopper empty. Flour keeps flowing
Feeder Problems - prevention

- Bridging – use of stirring device inside feeder hopper – agitator or screw mixing
- Tunneling – use of stirring device
- Mill stops, feeder continues – electrical interlock between mill and feeder
- Feeder empty or stops – audible alarm system
FORTIFICATION AT THE MILL

Equipment requirements

• Collection Conveyor with Paddles or cut/folded flights (maximize agitation)
• Feeder with mechanical or electronic controls to adjust feed rates
• Conveying system to deliver premix to flour
• Weigh Scale to verify premix addition rates (QC check)
Iron Spot Test Diagram

Iron Spot Test (AACC Method)

Sample  30 ppm  60 ppm  90 ppm

Based on spot intensity:
The sample has between 60-90 ppm of added Iron
Premix Control Records

• Why?
• To verify that premix is being added at the correct levels using inventory control system.
• Can be calculated weekly or monthly
Yemen Flour Mill Premix Stock Release form – millers copy
### Yemen Flour Mill

– QC Monitoring Report Form

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<tr>
<th>Run</th>
<th>MILL</th>
<th>T Date</th>
<th>FLOUR</th>
<th>PICKUP</th>
<th>SOURCE</th>
<th>BAG</th>
<th>MILL</th>
<th>SHORT</th>
<th>WEIGHT</th>
<th>SPEC</th>
<th>ADD</th>
<th>SPEC</th>
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<th>SPEC</th>
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<th>SPEC</th>
<th>SPEC</th>
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<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>24.2</td>
<td>2</td>
<td>N/A</td>
<td>N/A</td>
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<td>N/A</td>
<td>N/A</td>
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</tbody>
</table>
Premix Control Record Calculation

- A. Starting Inventory \( \text{kg} \)
- B. Amount purchased \( \text{kg} \)
- C. Ending Inventory \( \text{kg} \)
- D. Amount used \( (A+B-C) \) \( \text{kg} \)
- E. Fortified Flour produced \( \text{MT} \)
- F. Actual Addition Rate \( (D/E \times 1000) \) \( \text{g/MT} \)
- G. Target Rate* \( \text{g/MT} \)
- H. Percent of Target \( (F/G \times 100) \) \( \% \)
- * Based on supplier specifications
Accuracy of system
WFP Afghanistan Example

• 3 mills in Peshawar and Quetta
• Flour milled for WFP Afghanistan’s Women’s Bakery Project 1999-2005
• Based on premix stock release system tied to flour orders
• Final assessment
• Premix addition was within $\pm 3.0\%$ of target addition rate
For additional information, visit:

www.FFInetwork.org/wheatflour/atlanta08/
www.FFInetwork.org/wheatflour