Cost Evaluation Curves for Raw Potato (DM vs Cost)

Category: Reference

Model: COST-CURVE-2025

Description: Provides the mathematical model and graphs describing the cost per ton of raw potatoes as a function of dry matter %, including region-specific parameters (k), used to assess economic impacts during over-quality situations.

Contents

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1. Introduction

This document provides a comprehensive overview of the cost evaluation curves for raw potato in relation to dry matter (DM) content, specifically analyzing costs on a per-ton basis as a function of dry matter percentage. The model, designated as **COST-CURVE-2025**, integrates regional parameters (k) to reflect local economic conditions and operational factors.

The primary purpose of this model is to enable stakeholders within the potato processing and supply chain to assess potential financial impacts during periods of over-quality, when dry matter levels exceed targets, leading to adjustments in processing flow and costs. This document includes detailed mathematical formulations, graphical illustrations, and application guidelines for practical implementation.

2. Technical Background

2.1 Role of Dry Matter Content

Dry matter (DM) content significantly influences the processing quality and economic value of raw potatoes. Variations in DM affect peeling yields, frying performance, defect rates, and ultimately, the cost-efficiency of production lines.

2.2 Cost Components in Potato Processing

Key cost components impacted by DM levels include:

- Raw material procurement costs
- Dehydration and moisture management
- Processing efficiency and throughput adjustments
- Downgrading protocols based on quality

2.3 Data Sources Utilized

Cost data and region-specific parameters are sourced from recent line equipment manuals and Product Specification Sheets (PSS) from the past six months. Equipment manuals provide rated throughput, efficiency, and maintenance routines, while PSS documents list SKU targets, defect tolerances, and quality thresholds.

3. Mathematical Model

3.1 Model Overview

The model describes the cost per ton (\(C \)) of raw potatoes as a quadratic or linear function of the dry matter percentage (\(DM \)). It incorporates a baseline cost and a region-specific coefficient (k) which adjusts the curve based on local economic conditions.

3.2 Core Equation

```
C(DM) = C_0 + k \times (DM - DM_{target})^{n}
```

Where:

- **C(DM)**: Cost per ton at a given dry matter percentage
- **C_0**: Base cost per ton at target dry matter
- **k**: Region-specific coefficient (region factor)
- **DM**: Actual dry matter percentage
- **DM_target**: Target dry matter percentage (e.g., 21.8%)
- **n**: Exponent based on empirical data (commonly 1 for linear, 2 for quadratic)

3.3 Parameter Definitions

Parameter	Unit	Description	Typical Value
C_0	USD/ton	Baseline cost at target dry matter	50 - 70 USD/ton
k	USD/ton per (percentage units) (region-specific)	Coefficient reflecting regional cost variations	±10 USD/ton based on region
DM_{target}	%	Target dry matter percentage	21.8%

n	dimensional	Exponent for non-linear effects	1 (linear) or 2 (quadratic)

4. Graphical Representations

4.1 Cost vs. Dry Matter Curves

Figures illustrating the relationship between dry matter percentage and cost per ton are essential for visual assessment. Typically, these graphs display the quadratic or linear curve generated by the model, with annotations for target, over-quality, and under-quality regions.

4.2 Example Graphs

Below are example representations:

Figure 1: Cost per ton as a function of Dry Matter %, highlighting the target zone (21.8%), over-standard thresholds, and corresponding cost variations.

4.3 Interpreting Graphs

- **Baseline cost line:** Indicates C_0
- **Region-specific curves:** Adjust based on "k"
- **Over-quality zone:** DM > target + tolerance band (e.g., 22.1%)
- **Cost implication:** Higher costs associated with over- or under-quality points

5. Region-Specific Parameters

5.1 Defining Region Parameters (k)

The coefficient k adjusts the cost curve to reflect regional economic factors, operational efficiencies, and local market conditions. Determination of k involves analyzing recent processing costs, equipment performance, and local commodity prices.

5.2 Sources for Region Parameters

- Line equipment manuals (e.g., **BLAST-3000**, **FLO-150**)
- Past 6 months of PSS quality specifications and reports
- Regional market price indices

5.3 Regional Parameter Examples

Region	K Value (USD/ton)	Description
Region A (North America)	+8.0	Higher energy and labor costs
Region B (Europe)	-2.0	Lower operational costs, optimized logistics
Region C (Asia)	+5.0	Moderate costs with recent market fluctuations

5.4 Calibration Procedures

1. Gather recent cost data from operation logs.
2. Calculate average costs at various dry matter levels.
3. Fit the data to the mathematical model to derive the appropriate \(k \).
4. Validate against regional market reports and operational benchmarks.

6. Application Examples

6.1 Example 1: Cost Prediction at 23% DM

Given:

- C_0 = 60 USD/ton
- DM_{target} = 21.8%
- k = 8.0 USD/ton
- n = 1 (linear model)

Calculate cost at 23% DM:

- Document and review error logs periodically to refine models.

9. Enhanced Analysis and Scenario Evaluation

9.1 Over-Quality Scenario Assessment

Simulate various over-dry matter scenarios (e.g., 22%, 23%, 24%) to evaluate cost escalation and operational feasibility. These simulations inform capacity adjustments and strategic planning.

9.2 Sensitivity Analysis

Analyze the influence of parameter variations (e.g., change in k, variations in C_0) on the cost predictions to identify critical thresholds. Use statistical tools to quantify impacts.

9.3 Optimization Techniques

Apply optimization algorithms to determine optimal dry matter levels that minimize costs while maintaining product quality standards.

9.4 Scenario Example Table

Scenario	DM Level (%)