FormuSense
rapid product development software

Rapid Product Development (RPD)

Mitsubishi Chemical, Srixon Golf Ball

Learn more: https://prosensus.com/multivariate-case-studies/srixon-golf-ball-core/

Project Highlights

Objective:
Rapidly develop new, reformulated, and improved products at the minimum cost

Approach:
The key element was exploring possible formulations with materials that had not been used previously. Therefore, the inclusion of ingredient properties was critical to the success of the project

Dataset Provided:

Formulations
√ Rubbers
√ Oil
√ Polypropylenes (PP)

Ingredient Properties
√ Rubbers
√ Oil
√ Polypropylenes (PP)

Ingredient Costs
√ Rubbers
√ Oil
√ Polypropylenes (PP)

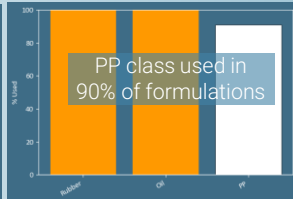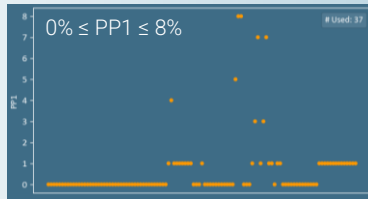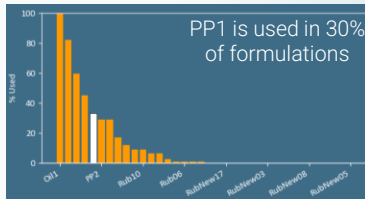**Process Conditions**
√

Final Quality
√

Results:
✓ Developed a new product (golf ball core) with specific properties using new ingredients
✓ Reformulated existing product at a lower cost

5% Cost Reduction

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0 Data (Import and resolve data integrity issues)

✓ Used Excel® template to format and import data
✓ Specified descriptor variables, resolved data entry errors, combined duplicate variables, resolved repeated errors with replacement rules

# of Unique Formulations: 111
# of Unique Ingredients: 36
# of Unique Classes: 3

1 Generate Ratios ($R_{ingredients}$ and R_{class})

PP1 is used in 30% of formulations

$0\% \leq PP1 \leq 8\%$

PP class used in 90% of formulations

Bar plots compare **frequency** of ingredient use

Line plots compare **variation** in ingredient use

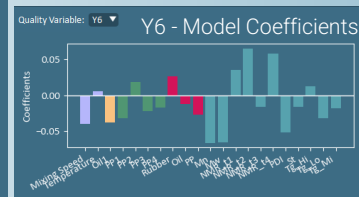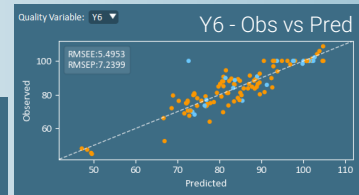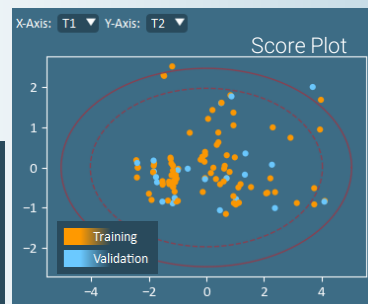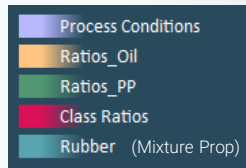Compare formulations with **Class Ratios**

2 Generate Mixture Properties

✓ Past formulations contain 1-5 rubbers
✓ Ingredient properties and ratios were combined with appropriate mixing rules to generate **mixture properties** for the **rubber class**

Rubber Class Mw
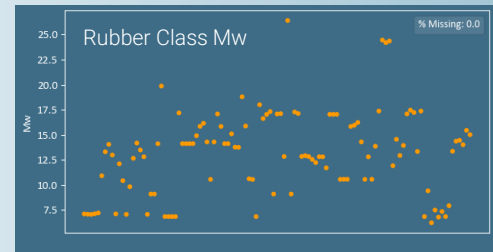
Mixture properties allow **new rubbers** to be considered in future formulations

3 Model Building (multivariate analysis)

✓ A **PLS** model for **7 quality variables** was built with 5 PCs on the x-blocks:

- Process Conditions
- Ratios_Oil
- Ratios_PP
- Class Ratios
- Rubber (Mixture Prop)

Score Plot
X-Axis: T1 Y-Axis: T2
Training
Validation

Quality Variable: Y6
Y6 - Obs vs Pred
RMSEE:5.4953
RMSEP:7.2399

Quality Variable: Y6
Y6 - Model Coefficients

4 Optimization

Once the model was built and validated, numerical optimization was applied to solve the design problem suggesting ingredients and combinations that achieve the quality targets of 7 key properties at the minimum cost.

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data driven innovation