BOSS™

Blending **O**ptimization **S**oftware **S**uite™

msa Celebrating 50 Years 1963 - 2013

Management Science Associates, Inc.

Blending Optimization Software Suite™ (BOSS™)

Management Science Associates, Inc.'s (MSA) Metals and Advanced Manufacturing Division has been providing blending optimization systems in the metals industry since our group's founding in 1982. The Blending Optimization Software Suite (BOSS) offered by MSA can deliver significant savings by helping to reduce the costs of raw materials. MSA's BOSS Charge Design determines the least-cost combination of materials needed to produce a given heat, line up, or production schedule, accounting for the various operating and quality constraints. A prime differentiator is the multi-grade/multi-heat capability whereby least-cost material requirements can be generated across any number (or campaign) of grades and heats. A 'Buy Plan' determines the materials to purchase for an order book or production schedule. An Alloy Additions calculation provides the determination of the least-cost set of materials to complete a melt. A ManMix calculation provides the capability to generate a predicted chemistry for a selected set of inventory materials and can be compared to a grade specification.

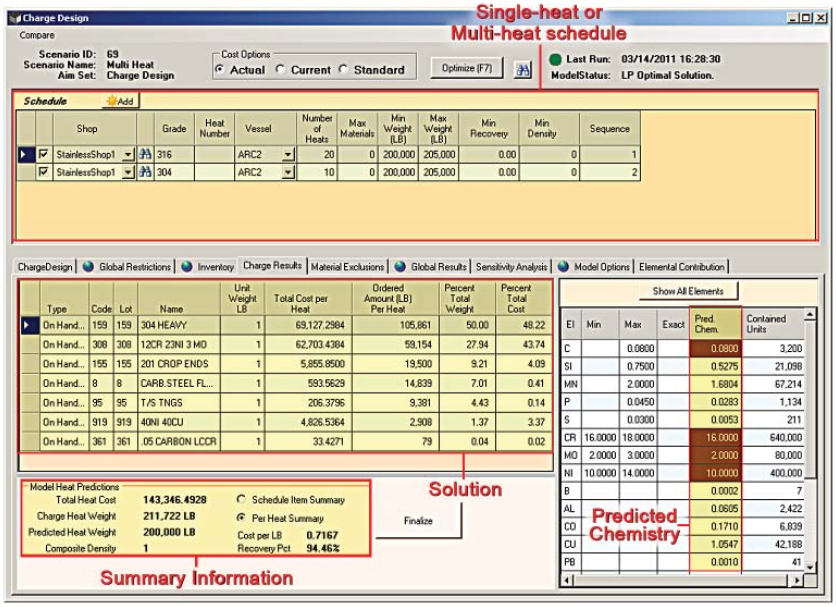
Demonstrable savings have been obtained for each component of the BOSS.

BOSS Models

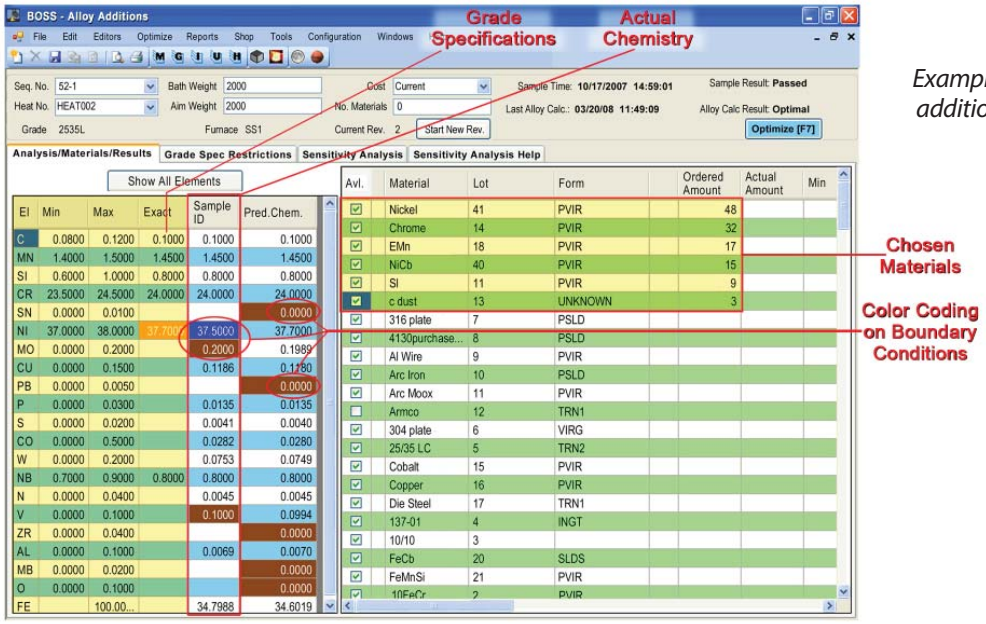
MSA's BOSS utilizes the latest techniques in mathematical programming to implement various optimization models, including:

- Purchase Planning
- Single Heat Charge
- Multi-Grade/Multi-Heat Campaign Optimization
- Alloy Additions Calculations
- ManMix Calculation
- Market Price Calculator
- Under-Crane Loading Optimization
- Marshalling Yard Planning

The blending optimization models consider the current inventory, available market materials, actual chemistry information, and chemical and physical constraints to calculate the least expensive mixture of materials to meet the specific requirements, along with the associated weight, yield, chemistry, and cost information. All models contained in the BOSS provide the ability to do "what-if" scenarios and to analyze the costs/savings associated with using alternative materials and various constraints.



Example of a multi-grade/ multi-heat charge design scenario.



Example of an alloy additions scenario.

Advantages & Features of BOSS

- State-of-the art mathematical formulations – via a third-party solver
- Very fast solution times
- Cost savings of multi-grade/multi-heat vs. single-heat optimization
- Sensitivity analysis information (i.e., reduced costs, dual prices)
- Assistance with diagnosing infeasible results
- Ability to limit the number of materials in the solution
- Ability to use materials in discrete quantities (i.e., unit weight materials)
- Minimum use amount constraints
- Ability to solve polynomial and non-linear fractional constraints
- Ability to filter material candidates by a variety of criteria
- Multiple user selectable inventory (on-hand, market, unlimited) and costing (actual, replacement, standard) options

Sensitivity Analysis

Sensitivity Analysis is a powerful tool to allow a better understanding of the costs of various constraints and opportunities related to material pricing. From the Sensitivity Analysis, the actual cost for holding to a specific chemistry (min/max) constraint can be determined. This information can be used to adjust working aims and can result in significant cost savings. Material price adjustment information is also provided, indicating the price change required for a given material to be used in a solution.

Cost Saving Examples

The savings cited below come from actual trials and studies conducted for clients.

- Savings of 3-8% (and greater) when no previous blending optimization was used.
- When an existing in-house optimization model or another blending system was being used, typically a 1-5% savings was noted, and:
  - An additional 1-3% savings was demonstrated due to a multi-grade/multi-heat simultaneous solution, providing for better utilization of inventory.
  - An additional 1-3% savings due to better purchase planning decisions.
- Savings of 5-8 % were demonstrated for an integrated mill by modifying their standard charge mix and expanding the types of scrap to consider.
- A foundry operation reported a 15% decrease in raw material costs when a purchase planning function was implemented.

Blending Optimization Trials

MSA can provide Blending Optimization Trials whereby clients' current mixes are compared against charges generated by MSA's BOSS package. These trials can be used to understand potential cost savings and more easily determine a return on investment (ROI) value.

About MSA's Metals & Advanced Manufacturing Division

MSA's Metals and Advanced Manufacturing Division has supplied integrated process automation systems and services to a variety of process and manufacturing industries. Industries serviced by MSA include steel, chemical, pulp and paper, laboratory, and environmental.

MSA specializes in providing turnkey computer systems, system design, and engineering and consulting services. Our process knowledgeable engineers and our technology expertise combine to result in leading edge systems and services for our clients.

Our mission is to improve our clients' productivity, quality, and profitability by providing innovative, reliable, and easy-to-use automation systems, on time and on budget.

msa Management Science Associates, Inc.

HEADQUARTERS
6565 Penn Avenue
Pittsburgh, PA 15206-4490

412.362.2000
800.MSA.INFO
info@msa.com
www.msa.com/metal

Pittsburgh
New York
Atlanta
High Point
Las Vegas
Cardiff
Kuala Lumpur
Shanghai

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