



BASF finds the secret to cleaner dishes and waterways

JMP® helps chemists uncover a substitute for phosphates

In July 2010, people across the US began to notice that the plates, cups and utensils coming out of their automatic dishwashers weren't as clean as they'd come to expect. The culprit was phosphates – or, more accurately, the absence of phosphates.

Phosphates are pros at stripping away food particles and grease, but once they find their way into lakes and streams they can disrupt the ecosystem by causing algae blooms that block sunlight and rob the water of oxygen.

So in the summer of 2010, 16 states banned the sale of household

dishwasher detergents containing more than 0.5 percent phosphorous. Detergent manufacturers responded by eliminating phosphates from all their products.

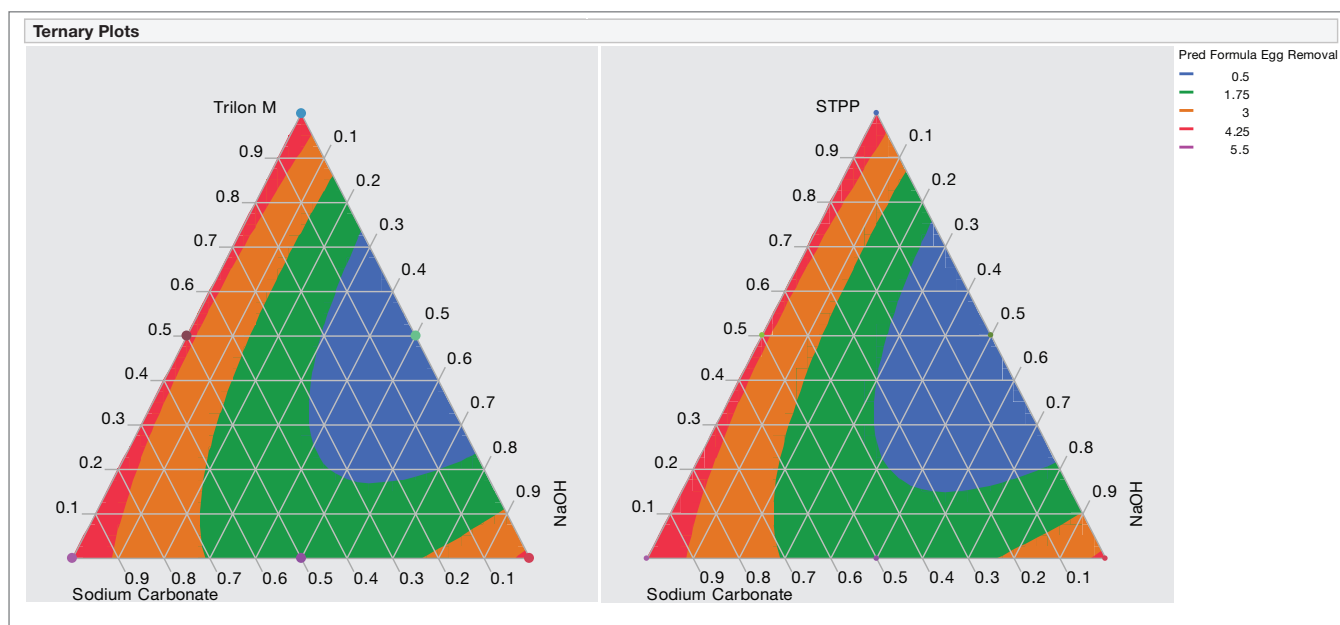
Researchers at BASF, the world's largest chemical company, needed to find an agent that could replicate the cleansing properties of phosphates. That task fell to chemists in BASF's Care Chemicals division, including Global Technical Key Account Manager Jim Dailey.

"As chemists, we're always looking for synergies," says Dailey. "And in this

case, we wanted to find a chemical composition with a synergy that would produce the desired properties.

"Our objective was to find mixtures of chemical compositions with cleaning properties akin to phosphate."

In the end, JMP® statistical discovery software from SAS helped demonstrate that a mixture containing a BASF product called Trilon® M and other builder compositions proved to be the most effective replacement for phosphate. Trilon M is the first product of its kind to be certified by the Environmental Protection Agency's



These Ternary plots show model comparisons between Trilon® M chelate (left) and STPP (sodium tripolyphosphate, right) for egg removal ability in institutional dishwashing formulations. They illustrate that Trilon® M acts as a functional replacement for STPP for cleaning.

“I’m a chemist, not a statistician, and I’ve come to really appreciate how JMP makes things so quick and easy.”

Jim Dailey

Global Technical Key Account Manager, BASF

Design for the Environment program. Builders are inorganic compounds that add alkalinity, which boosts cleaning.

When Dailey and his fellow chemists initiated their work on phosphate replacement, they turned to JMP, which promotes discovery by dynamically linking statistics and graphics, in memory and on the desktop.

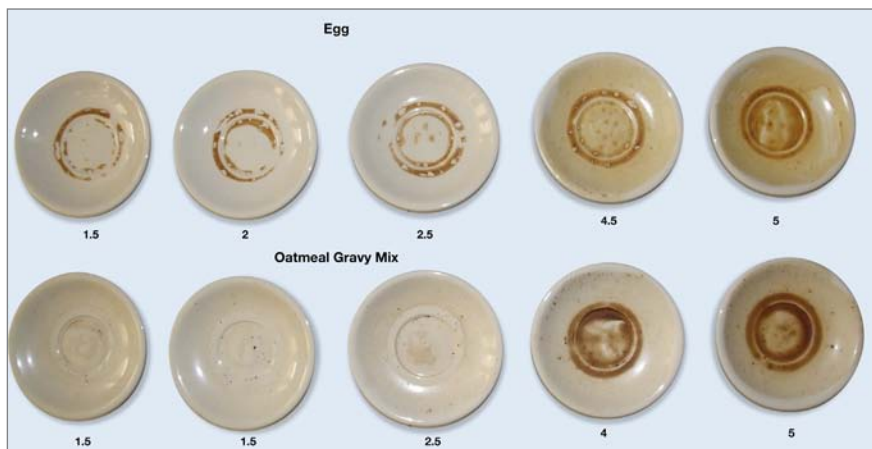
Not only did JMP help Dailey and his colleagues explore their data more effectively, the software proved to be a tremendous timesaver. Using design of experiment tools in JMP, Dailey’s team performed multifactor experiments on various mixtures. Dailey credits JMP with slashing design time by 75 percent or more.

“I’m a chemist, not a statistician,” Dailey says, “and I’ve come to really appreciate how JMP makes things so quick and easy.

“Design of experiments allowed us to cover the space with a minimum number of experiments,” he explains. “We could then model the data and estimate the performance where we hadn’t even done an experiment, then go back and confirm it.”

The kitchen test

The BASF Care Chemicals division produces a broad range of products – including surfactants, polymers, emollients, chelating agents, UV filters and biocides – that are used for personal and home care, industrial and institutional cleaning and technical applications. Clients of BASF include some of the world’s largest consumer and commercial cleaning conglomerates.



This photo shows examples of a rating system for egg and oatmeal deposits. The rating system is used to determine the cleanliness of the plates after washing in an industrial dishwasher.

Dailey works in research and development, which is how the phosphate issue landed on his desk in 2008. With the movement to eliminate phosphates already afoot, Dailey launched a project to evaluate formulations for phosphate replacement in industrial and institutional cleaners.

Using JMP, he began to evaluate the performance of synergistic combinations of ingredients in institutional dishwashing, industrial laundry and hard-surface cleaning formulas. One experiment involved baking eggs, oatmeal and gravy onto saucers, and then washing the plates in an institutional dishwashing machine.

“We devised a test method that would indicate differences between formulations,” Dailey says. “We then did a three-level mixture design and used JMP to quite effectively model that space. In this case, we were looking at combinations of chelating agents, polymers and builders.” In dishwashing

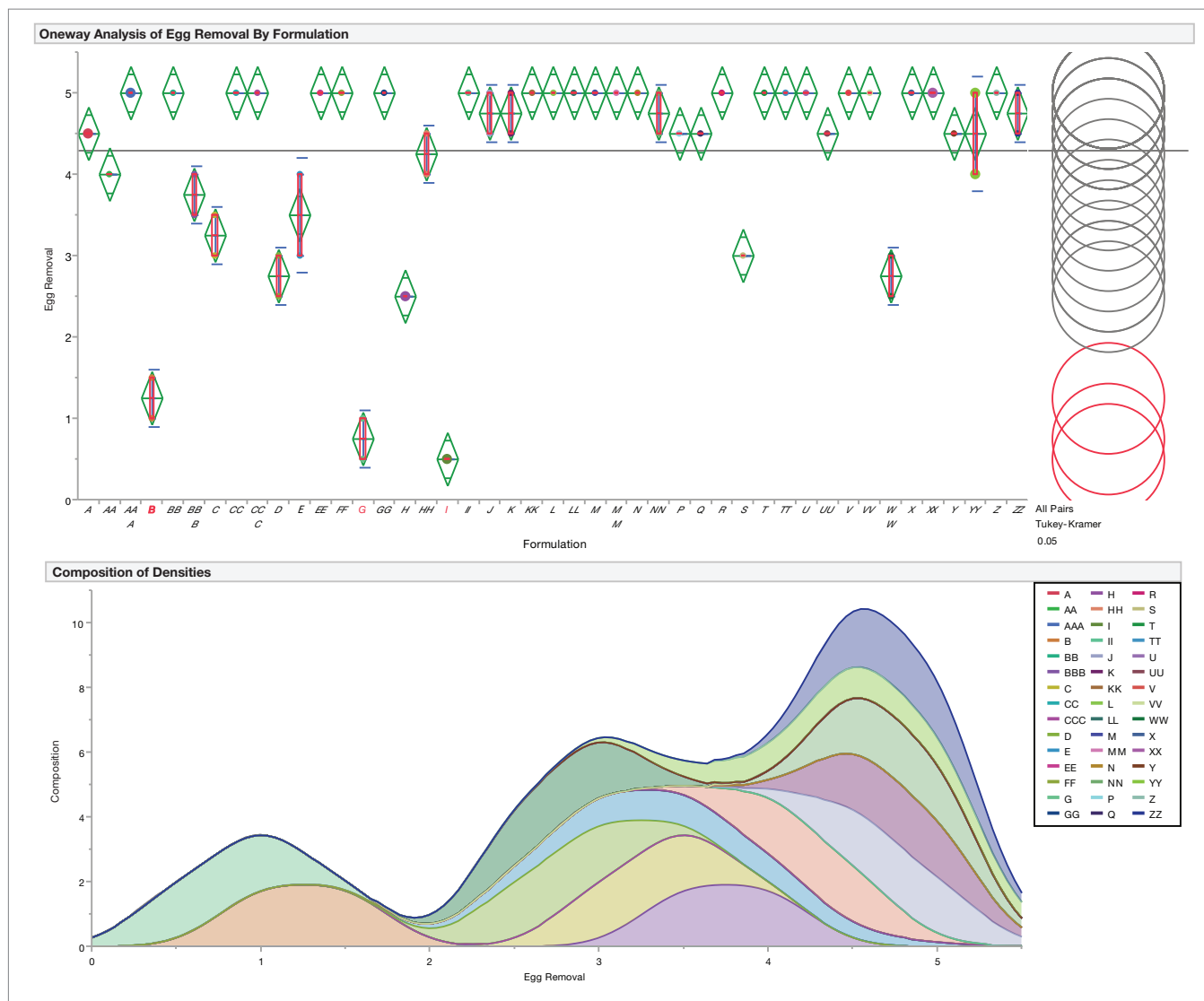
detergents, chelating agents counteract metals in the water that deter the cleaning process.

Dailey and his team selected seven components for the mixture design, examining the effectiveness of each formula. They discovered that certain mixtures cleaned as effectively as products that contained phosphate.

“JMP allowed us to see this,” he says.

Having identified compositions with the right synergies, Dailey then used JMP to maximize performance while minimizing cost. “Applying desirability functions to the JMP Profiler allowed us to easily maximize the desirability of both responses,” he says. “We found the best removal of egg at the lowest cost.”

BASF’s customers have confirmed the cleaning benefits of its Trilon M chelating agent and are now using it in their institutional cleaning products.



The Oneway Anova plot shows significant differences in the egg removal ability for the different formulations evaluated.

'So useful in so many ways'

For Dailey, multifactor experiment capabilities in JMP have helped bring clarity to research findings, in addition to saving him time.

"I'm often unable to draw clear conclusions after one-variable-at-a-time experiments," he says. "But with models developed using the JMP Custom Design platform, I can clearly visualize sweet spots in performance, and I'm always confident in my conclusions."

Dailey frequently uses the JMP Graph Builder, which lets him interactively build a graphical analysis by dragging and

dropping selected variables onto X and Y axes.

"It's so useful in so many ways," he says. "You can start exploring your data and get familiar with it a lot more quickly."

Data filtering is another favorite feature, particularly when Dailey works with very large tables. He's able to filter out specific rows in real time, another big timesaver.

He also appreciates means-comparison capabilities in the software. "JMP is such a powerful tool because it allows

CHALLENGE

Responding to a mandate to remove phosphates from detergents, a team of BASF chemists set out to find a chemical composition with similar cleaning properties.

SOLUTION

JMP® statistical discovery software from SAS helped the team evaluate the performance of a variety of compounds and proved to be a considerable timesaver.

RESULTS

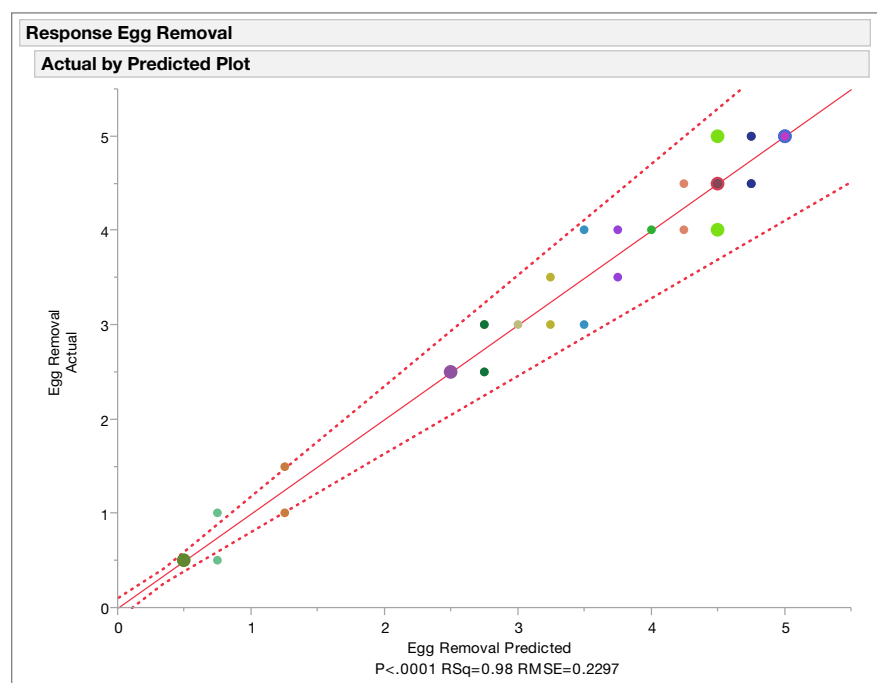
Using JMP, BASF chemists designed a new cleaning formulation now used in place of phosphates by dish detergent manufacturers around the world.

you to effectively compare means with confidence intervals,” he explains.

“A lot of people don’t compare means correctly, or they don’t compare means at all,” he explains. “I preach to our group that people need to show their repeatability and show if one product is better than another using a means comparison.

“That’s so important, and JMP does it very well.”

More meaningful results more quickly is certainly good for business – and, in this case, for lakes, streams and dishes.



The Actual by Predicted Plot shows how well the model of egg removal fits the measured data.



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