The UREKA Moment!

The problem had been there since the inception of the carrier, and none of the studies or investigations had proven fruitful, but the desire to improve the consistency of this carrier was ever present. During an annual visit with our supplier of LO-77-203 we brought up the topic with the vendor and asked them what else we might look at in terms of raw material quality. We had tried to correlate every raw material quality parameter to our carrier variability and nothing had worked. We could not complain about the quality of the raw material because it met all of the established specification ranges, but we wondered if there might be other parameters not reported on the Certificate of Analysis (COA) that could be contributing to the variability seen in the manufacture of BR-549.

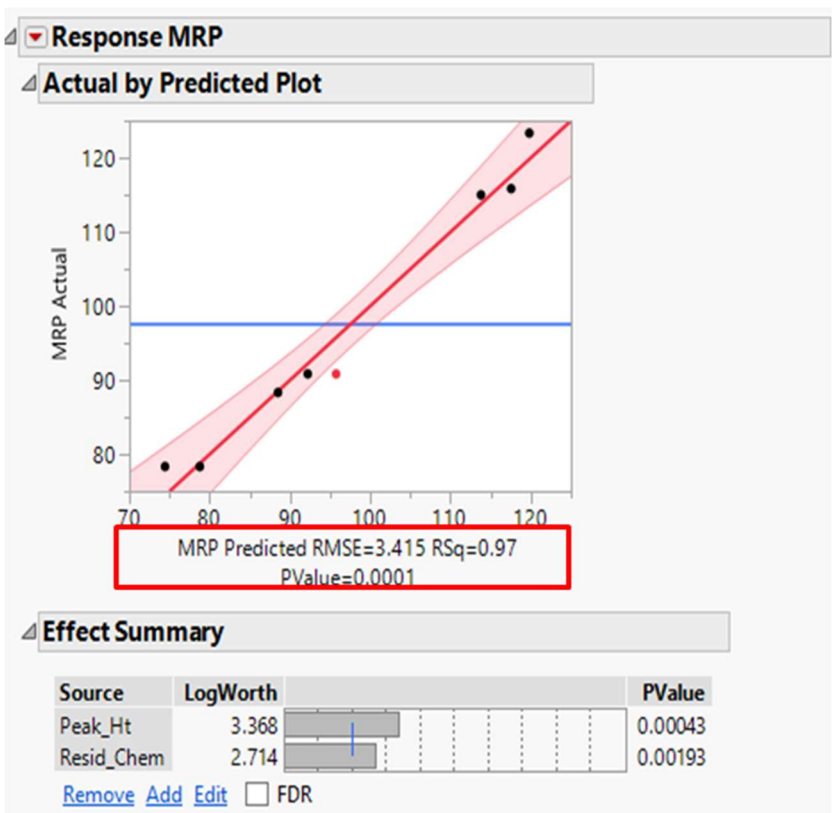
Our supplier described their process for manufacturing our raw material. In this process description they mentioned that they pre-processed one of their raw materials prior to using it in their manufacturing process. Their raw material was pre-processed for varying lengths of time based on an internal quality measurement they called Peak Ht. They believed that their raw material needed to exhibit a certain Peak Ht in order to be good – but this was an internal measurement of a raw material only – not something that showed up on our LO-77-203 COA. Being a conscientious supplier, they agreed to share data with us to assist in our trouble shooting and investigation.

The processing time for their raw material did not correlate with our MRP results. We could make good carrier from lots of LO-77-203 that processed quickly as well as those that "took forever" to process. The Peak Ht results from their pre-processing step was also a dead end. With the historical data they shared we re-ran the models from our previous experiments adding a few new independent variables and finally noticed what we thought was a glimmer of hope – it appeared that the Peak Ht (a measure of their raw material pre-processing) in conjunction with one of the parameters routinely reported on their COA (a residual chemical measurement) might be telling us something. We asked the supplier about this idea and they confirmed that the residual chemical in the LO-77-203 was something they were compensating for with the pre-processing step in their manufacturing process. Since their pre-processing targets were always the same, we really only had one data point, but we had a LOT of replication at this point. They were agreeable to provide some test product to help us determine if these things were in fact related to our carrier variability issues.

The Results

Our R&D engineers took the experimental raw materials back to their lab in Ohio and went to work. Within a week they called the plant excited about the bench scale results and wanting us to set up commercial scale testing of these batches of raw material. We had a small window of opportunity open up and scheduled the commercial tests for the following month. Here are our results:

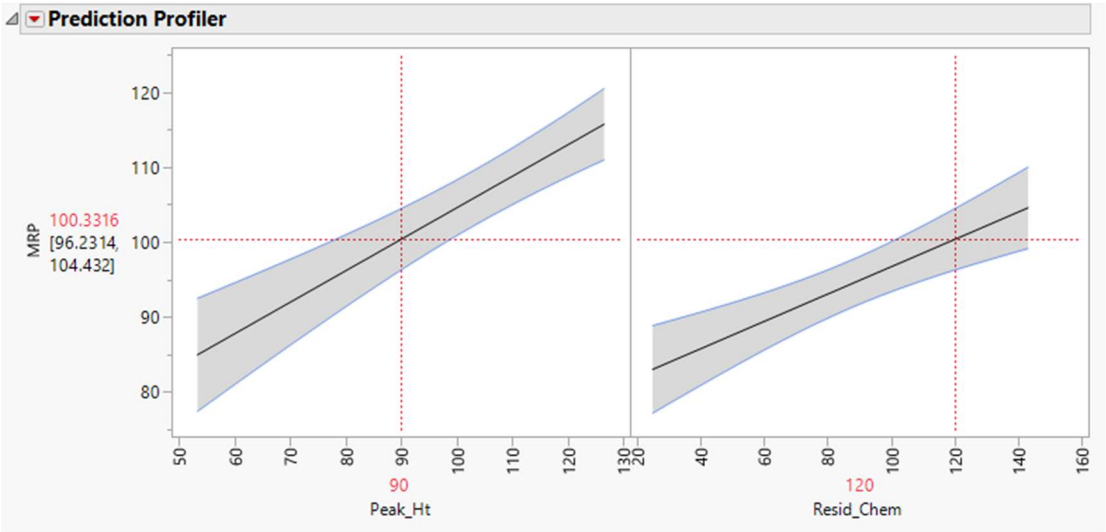
	RM_Lot	Design_Pt	Peak_Ht	Resid_Chem	MRP
1	X-5742	Low/Low	73.2	40.4	78.33302
2	X-4655	Center/Center	95.7	81.7	90.83297
3	X-9981	Low/Low	69.6	24.9	78.33302
4	X-6767	Low/High	53.4	139.5	88.33298
5	X-9969	High/High	126.3	143.2	123.33284
6	X-5578	High/High	123.3	117.1	114.99954
7	X-1368	High/High	126.6	130.1	115.83287
8	X-7375	Center/Low	98.7	55.4	90.83297



An R-Square of 0.97. With main effects only. No interactions. No accounting for curvature in the model. No processing parameters. Actually we ran the model as a response surface and found we could get an R-Square of 0.98 but decided that the improvement in the model's usefulness was not justified by the additional complexity introduced with the 2nd order and interaction terms. The more complicated model may have been just as "right" but no more useful to the manufacturing guys.

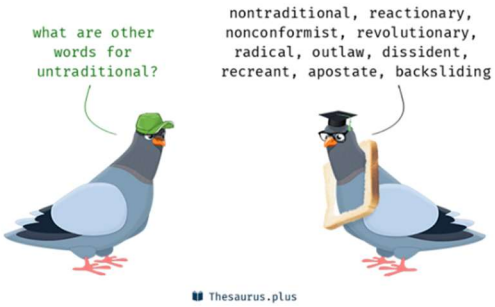
The Profiler

ChemCo's specifications for MRP were 90 – 110 with a target value of 100. Our existing LO-77-203 raw material specification for residual chemicals was a maximum of 100ppm. We had never heard of Peak Ht so we had no spec range established for this parameter.



Looking at the prediction profiler in JMP, we could see that we had been rejecting a LOT of raw material based on the residual chemical results that would make perfectly good carrier, as long as that raw material was processed to a certain Peak Ht. Not only would we NOT be able to set specifications around the Peak Ht, the specs we had established for residual chemical were not useful. What we needed was a way to ensure that the raw material would make a good product and the traditional specification range method was not going to work for us.

Non-Traditional Spec Setting



The statistics involved here are relatively simple compared to the much more difficult challenge of changing the culture of a company. Saint-Gobain was established in 1665. They have had over 350 years to become established in their ways! It took several meetings with R&D, Purchasing and Commercial folks before everybody was comfortable setting raw material specifications based on a statistical model of how that material impacts our carrier rather than independent measures of the "goodness" of the raw material. Eventually the group decided that non-traditional could be innovation and that innovation is a good thing. Also, we didn't really have any other useful options on the table. We learned how to save our model in JMP, then create a profiler that could be run independent of the JMP application. We made a trip to Europe to visit with the supplier and propose a contract change wherein NorPro would accept any lot of LO-77-203 that predicted an MRP value between 90 and 110. The closer to 100 you can come the better we'll like it. Here's a thumb drive with the model. What do you say?

5. Share the HTM file

JMP creates an SWF (Shockwave) file as well as an HTM file. Double click on the HTM file and the profiler will open up in your default browser. The end user will need to have Adobe Flash installed and enabled on their computer for this to work.

To close the loop, here's the instructions we issued to the supplier along with the profiler shown above.

A. Slide the Resid_Chem vertical bar to the value represented by your raw material lot
B. Slide the Peak_Ht vertical bar left or right as needed to obtain an MRP target of 100
   - The MRP spec is 90 – 110
C. Process your raw material lot to the necessary Peak_Ht value

Follow-up

Over the course of the coming months the supplier typically provided LO-77-203 raw material with an MRP prediction of 97-103 versus our spec of 90 – 110, far exceeding our requirements. After two years of operating under this new philosophy our customer (ChemCo) suggested that our process capability for BR-549 was so greatly improved that we should consider narrowing our product specification. We cut our spec range in half and still had a capable (Cpk = 1.33) process!