

Improving Quality at Holliday Pigments using Data Mining



“The project challenged our existing views with regard to data analysis and has given us some valuable extra options as we consider our future strategy”

**Dr David Calvert,
Holliday Pigments Ltd**

Holliday Pigments Ltd is the world's largest manufacturer of ultramarine blue pigments. With UK operations based in Kingston upon Hull and a second manufacturing site in France, the company exports to over 80 countries. With over 50% of worldwide sales, the company is committed to maintaining its market leader position by continuously examining new technologies.

Unlike many chemical products manufactured today, ultramarine blue is inherently sustainable. With naturally occurring clay as its primary raw material, the company's products are environmentally friendly and its production processes exceed all relevant emissions regulations.

The unique colour properties of ultramarine blue are exploited in many applications, such as plastics, inks, packaging, paints, cosmetics. and many more. An ever-increasing range of new uses drives the company's continual goal of product diversity and quality improvement.

The manufacturing process is highly complex and multi-stage; part batch, part continuous. As with all such processes, consistency is the key to maximised quality. This can only be achieved by an in-depth understanding of the causes of process variability, often in areas where the relevant values cannot be measured directly, for instance in high temperature kilns. This understanding enables rapid tuning of the process parameters to react to perturbations at a very early stage, minimising the effect on final product quality.

Holliday Pigments was one of 19 chemical sector manufacturers and trade associations to be selected for an audit by the DTI-funded e4C Programme. During the audit, the issue of increased consistency of process conditions was identified as a key opportunity for further product quality improvement. Following a review by the Steering Committee, the company then became one of the 13 organisations to be offered a further pilot project, also provided by the e4C Programme.

The Project

Firstly the manufacturing process was “mapped”. The major steps were identified together with the variables - physical, chemical and operational - which were being recorded. At a series of workshop sessions, the company's process experts, together with consultants from the e4C Programme, identified the many variables which could potentially have an impact on process conditions and hence final quality.

Sources of data, such as existing process control computer systems, were also examined, and discussions held with the system developers to identify optimum methods of extracting and analysing the substantial amounts of data which exist.

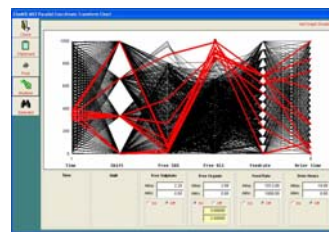
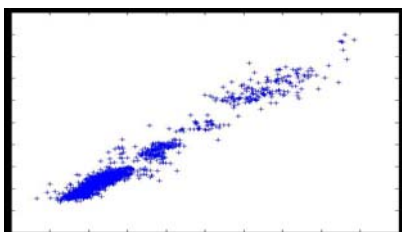
The results of earlier data analysis exercises commissioned by the Company and using a variety of techniques were also discussed and assessed. It was then identified that the remaining causes of perturbation are probably not univariate in nature but multivariate. This type of problem can be highly complex and is not usually solvable by means of essentially univariate analysis techniques. For instance, statistical process control methods such as XBar/Range (also called Shewart) charts, are often highly effective where a single variable is the issue, and are much used in industry, but in situations where variables interact they are largely irrelevant.

Another likely issue which was identified at this time is the probable need to use advanced analytical techniques including those suitable for difficult (or hitherto impossible) measurements, for instance those in aggressive environments or in which the sample is not directly accessible.

Accordingly the e4C consultant investigated current best practice in the area of multivariate statistical analysis and process control. This technology is now becoming applied to complex situations in many areas of manufacturing including many advanced process manufacturing applications such as chemical reactors and pharmaceutical fermentation. Discussions were held with acknowledged leaders in this field including specialists from the Centre for Process Analytics and Control Technology (CPACT), a consortium of the Universities of Strathclyde, Hull and Newcastle together with many industrial partners. These discussions confirmed the likely applicability of techniques including Principal Component Analysis (a multivariate technique in which a number of related variables are transformed into a set of uncorrelated variables) together with advanced chemometric analysis. Another tool which could be beneficial when applied to a unified database is the Parallel Co-ordinate Transform.

The e4C pilot project concluded with the following recommendations to Holliday Pigments:

- A unified database be designed and developed to combine data from several disparate sources, to provide basic data mining tools like the parallel co-ordinate transform and to support more complex multivariate statistical analysis such as principal component analysis
- Applicability of multivariate analysis be investigated in depth by CPACT



Examples of principal component analysis (left) and parallel co-ordinate transform (right)

The consultancy provider was AJM Consulting Services Ltd,



AJM Consulting Services Ltd
Europarc Innovation Centre
Europarc, Grimsby
N E Lincs DN37 9TT
Tel: 01472 500306 Fax: 01472 500307
Email: info@ajm.co.uk

www.ajm.co.uk