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Ashes victory

A long established process plant in Cheshire wins the award for Innovation in Structural Engineering at the recent Bentley 'Be Inspired' 2011 event

In the heart of the plains of Cheshire, North of Northwich, is a smaller district called Winnington, renowned as the site of the accidental invention of Polythene at a soda ash plant originally established by Brunner Mond, one of the four companies that originally founded Imperial Chemical Industries (ICI), now owned by the Tata Group of India since 2006. The process plant, and the rather large structure that contains it, now has another reason for pride, as it has just won the Innovation in Structural Engineering at the Bentley 'Be Inspired' Awards held recently in Amsterdam.

The Winnington facility is the largest manufacturing plant within Tata Chemicals Europe and is the largest producer of soda ash in the UK. However, the most interesting aspect of the process plant is probably its age. The original soda ash plant was commissioned some 137 years ago, with progressive enlargements, additions and enhancements to processing equipment and infrastructure over the subsequent century.

What is soda ash used for? Take your pick - it is the major ingredient in the manufacture of flat and container glass, is used in detergents, and it's pretty handy for stripping flesh from bones for taxidermists too. The market for this key commodity chemical is diverse and remains buoyant. In common with all manufacturers a key challenge for Tata Chemicals Europe is to manage and improve its asset base to ensure ever more reliable delivery of product into these markets for another hundred years.

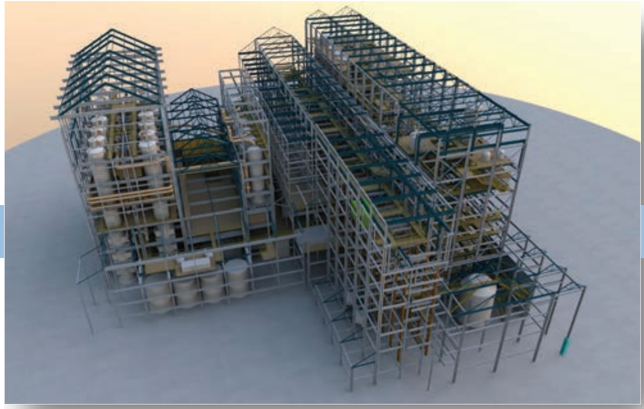
The supporting structure, originally built around wooden columns, is now a complete structural steel shell, clad in corrugated steel panels. Tata Chemicals Europe has developed a comprehensive Major Asset Programme (MAP) to assess the criticality of its key assets - including infrastructure - and prioritise capital replacement programmes. They first had to ascertain its state of repair, and called in Stopford, process plant consultants, to handle it using state-of-the-art technology.

David Coupe, the Piping department Manager at Stopford Project told me about the two choices they had. The first was to conduct an as-built survey using 3D surveying to acquire a point cloud model of the structure and its processing equipment, and the second, to refer to their previous construction records, of which they, amazingly, had a complete set going back to the first building they had erected - and which were also in good condition.

The 3D survey was rejected. The 671 drawings they had, the earliest from 1908, were sufficiently comprehensive to enable Stopford to create a complete 3D model of the plant, and well preserved, having been made with pen and ink on linen paper, assisted by full knowledge of the dimensions and geometry of each of its components from a custom steelwork library that stretched back to 1906. In fact 95% of the 3D model was derived from the original plans, and just 5% from CAD drawings produced earlier.

Explaining why a 3D survey of the building had not been thought worthwhile, David explained that the point cloud it would have produced might have been very accurate, but would not have been accompanied by the amount of intelligence about the plant that they had been able to devise from the 2DS drawings. A point cloud survey would also capture unwanted background data such as scaffolding

Armed with the information they had, Stopford were able to create a detailed 3D model of the plant so that they could



perform structural analysis on the building. This included 13 primary models, 15 secondary structure models, including over a hundred stairs, and 13 other piping and equipment models. Most of the structure was built in the early 1900s, with columns, beams and bracing being mainly riveted together to provide the required rigidity. Underlying this is the original, late 19th century, heavy timber construction with cast iron brackets at the connections.

The next step was to bring the information they had up to date by creating inspection drawings. The original drawings, naturally enough, related to the pristine state of the structures when it was first erected, and took no account of the depredations of the past century. A survey was conducted of the condition of each of the structures members, conducted principally through physical inspection, assisted in some of the more inaccessible places by long-range photos.

This showed which beams had been affected by corrosion, and by how much, and the information gathered was entered in the 3D model to modify the structural load bearing qualities of the plants constituent parts. The individual components were colour coded, following the survey, showing grey for those with no defect, yellow for a small amount of defamation, and red for severe defects.

Running structural analysis through suspect parts of the building highlighted areas of concern, where remedial work was to be focused, and when.

Subsequent surveys will enable the company to update the 3D model on a regular basis, and to ascertain the impact of remedial work, as and when necessary. It is to be hoped that creating a detailed model of the building will enable Tata to keep the soda ash plant in a viable state for the next 100 years! Such process plant operations have long term investment strategies - 50 years as opposed to just 5 years.

The 3D model has provided Tata Chemicals Europe with an excellent foundation to a significant safety improvement campaign they have commenced and offers numerous other potential benefits, such as plant safety inductions, operator training and reassessment of emergency evacuation routes. It also reduces the amount of paper work that will have to be handled whenever structural issues are raised about the plant.

METHODOLOGY

Stopford Project used Bentley's Prosteel workframes to construct a set of inspection general arrangement drawings, containing numerous sectional views of each floor. These were annotated directly from the prosteel model database element numbers, and a complete as-built structure was modelled. This was a simple process using Prosteel. Changing structural section sizes automated the resizing of connecting elements and referenced directly into the general arrangement drawings. Changes from site surveys were subsequently fed back into the model.

Weekly client meetings were held to keep track of the process, using Bentley Navigator, in I-Model and progressive PDF views. Visual images were useful for the client stakeholders to see the ongoing plant improvements for themselves, and the operator training and environmental aspects of the process - showing the improvement in working conditions, and enhancements to the buildings aesthetics.

Stopford Projects has also delivered an intelligent 3D model to its client, capable of being converted to AutoCAD solids or as an Acis model. The model also interfaces to Bentley's STAAD.Pro and AutoPIPE for follow-on projects - perhaps a full structural analysis of the building using STAAD.Pro. As the existing pipework was modelled using AutoPLANT V8i, conversion using briefcase technology will enable it to produce a stand-alone piping model, capable of producing BOM reporting and isometric generation.

INNOVATION AWARD

It was felt by the jurors at Bentley's Be Inspired event that Stopford Project Limited showed great imagination throughout the development of the Tata Soda Ash project, but, even more importantly, demonstrated that modern software techniques could be utilised, similarly, in other process plant refurbishments and development - a fact proved by ongoing discussions with other plant operators in the area with the same issues as the Winnington plant.
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