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WORSLEY ALUMINA EXPANSION PROJECT

FEATURED IN THIS ISSUE:

After-fabrication galvanizing plays a critical role in value engineering design by influencing:

- schedules
- quality
- project control
- contract co-ordination
- risk reduction

WORSLEY ALUMINA EXPANSION PROJECT Western Australia

Outline of Objectives

The purpose of the Worsley Joint Venture extension was to increase refinery capacity from 1.88mt/pa to 3.1mt/pa at minimal cost, within the shortest project duration. To achieve the objectives required innovative process and plant design, creating an obvious opportunity to introduce the latest technology.

During the feasibility study for the new plant, existing construction practices were carefully scrutinized with the object of finding maximum efficiencies to establish economic justification.

Existing methods and materials were re-examined and previous industry standards challenged to find the optimum specification.

Planning and Construction

As reported by the Australian Steel Institute's Manager for Western Australia and South Australia, Rupert Grayston,

"The construction manager for the project was the Kaiser Bechtel Joint Venture (KBJV) with United Constructions, the main steel fabricator, being part of the integrated team.

The project was completed without interrupting the operation of the existing plant where work included extension of currently operating units.

Accurate and timely supply was critical to meet the tight requirements of the program, which included the delivery of 8000 tonnes of structural steel work over a 12-month period.

The success of this planning was confirmed by achievement of a series of key performance measures ranging from high quality fieldwork through to time and material savings.

KBJV used 3D structural modelling software coordinating with detailing and fabricator's software to manage stocks and for numeric controlled process machinery".

According to Chief Structural Engineer, Paul Rushton, "The 3D technology applied simultaneously to design and detailing allowed the structures to be built in 'virtual reality' in the design office, with concurrent referencing of the models from the other disciplines. In this way no surprises occurred later on-site, and fit-up to existing structures was excellent."

"The design process was completed by re-importing the steel detail model back into the 3D process. In this way, clashes with the components of other disciplines such as chutes, equipment, piping etc were eliminated," said Rushton.

Steel Protection

In the context of the design upgrade, past practice had been to avoid metallic coatings for steel protection. This had been done on a precautionary basis and with respect to the chemicals used in the alumina process.

However on examination of existing galvanized items dispersed throughout the plant, such as cable trays and other steel auxiliaries, excellent service life was proven, prompting its consideration in the reassessment.

Particular value was found in galvanized steel handling capability, solar radiation (UV) immunity, sharp edge protection and other characteristics complementary to the design capability of steel.

Also of significance, after-fabrication galvanized coating confers environmental cleanliness, sustainability and a wholly Australian content system.

Collectively these contributed to construction efficiency and to low life cycle cost and led to its adoption for the project.

Summary

Rupert Grayston commented that "The Worsley experience has shown that an intense focus on Total Installed Cost is the meaningful project management parametric of the new workflow.

In addition to the cost benefits, this new approach offers:

- Schedule improvements
- Quality improvements
- Improved project control
- Contracting flexibility
- Reduced risk

The Worsley Expansion Project has represented a significant step forward in new technology utilisation for the steel construction industry. As software products and integration techniques continue to advance, and as subsequent projects further push the boundaries, the performances of Australian projects and industry will continue to improve."

Acknowledgements:

Paul Rushton, Chief Structural Engineer, Kaiser Bechtel Joint Venture (KBJV)

Rupert Grayston, Western Australia and South Australia State Manager, Australian Steel Institute

PASMINCO

2002 SOREL AWARD
FOR INDUSTRY ACHIEVEMENT

The Comalco Alumina Refinery (CAR) Project

The level of entries for the annual Pasminco Sorel Award for achievement in the hot dip galvanizing industry was outstanding and after much deliberation the judges awarded the 2002 Sorel Award to John Holland Galvanizing (formerly Transfield Galvanizing Queensland) for their entry titled "The Comalco Alumina Refinery (CAR) Project – Project of an exceptional order".

Two other entries were highly commended:

GB Galvanizing for the "Carousel Pavilion – Steampacket Quay Geelong Waterfront Redevelopment"

and

Meneghello Galvanizing Service for "Continuing Commitment to Occupational Health and Safety at the Workplace".

The annual industry award is presented by Pasminco Metals to recognise current and significant contributions to the enhancement of general galvanizing with respect to marketing, product development, process and environmental innovation.

These entries embrace the 166 year old patent for a method of protecting iron & steel from rust as filed by Stanislaus Sorel, a civil engineer working in Paris who pioneered zinc coatings. After-fabrication galvanizing involves a process, virtually unchanged since 1837.

Listed below are some details of this year's entries from the hot dip galvanizing industry in Australia and New Zealand.

"Comalco Alumina Refinery, Project of an exceptional order" Qld – John Holland Galvanizing

An object lesson in efficiency, John Holland Galvanizing offered Bechtel a "One Stop Shop" for all stages of the structural steel production. Pivotal to the bid was the ability to provide the client with a seamless process inclusive of steel fabrication, protective coating, manufacturing, consolidation and site erection.

"Occupational Health and Safety at the Workplace" – A social responsibility" Meneghello Galvanizing Service, WA

WorkSafe, the Department of Consumer and Employment Protection, Government of Western Australia awarded a Silver Certificate Achievement status to Meneghello Galvanizing for the WorkSafe Plan system for continuing commitment to occupational health and safety.

Subsequent to receiving the Sorel Award, Meneghello Galvanizing has achieved Gold Certificate status – the first to be awarded to the galvanizing industry in Australia.

"Geelong Waterfront Redevelopment – Carousel Pavilion" GB Galvanizing Service Pty Ltd, Vic

The concept for this project arose from the City of Greater Geelong's management of the waterfront upgrade where an elegant steel framed structure was to house an operating 19th century steam carousel as well as creating an attractive restaurant.

The steel frame of the building comprises six umbrella forms sculpted to reflect roof loads with minimal use of diagonal bracing in roof or walls.

This unique galvanized building was designed to withstand high wind loading, the effect of constant salt spray and chloride deposition and to satisfy the need for unusual architectural features.

"Treatment of Quench Waters – A good look for galvanizing" Geelong Galvanizing Pty Ltd, Vic

Disposal of quench water and desludging is a very expensive exercise. Geelong Galvanizing, in consultation with their chemicals consultant, introduced an innovative procedure that has transformed the way the galvanizing plant deals with its spent treatment water.

"Waste Saves Resources" Sunstate Coatings, Qld

A client sought Sunstate's advice regarding the supply of galvanized bins to coastal areas, observing that the maintenance on galvanized bins was far less than that of the painted bins supplied to other areas. By hot dip galvanizing all the industrial waste bins, there was a marked reduction in the cost of repairs and maintenance. Other benefits arising from the conversion were a reduction in health and safety issues associated with painting, long term clean appearance, handling efficiency and twice the life expectancy.

"Bullbar Production – Extra Thick Galvanizing" Southgalv Ltd, New Zealand

These terrain vehicular bullbar assemblies consist of 12 items weighing a total of 10 kilos. Historically they were centrifuged or electroplated to accommodate easy zinc application but with significantly greater maintenance cost.

Southgalv worked closely with the proprietors to introduce hot dip galvanizing of the articles and produce a finish that would give them greater longevity through the thicker coating produced by the after fabrication galvanizing method. Southgalv had to supply a superior finish and appearance as 70% of the bullbars are exported.

"Waste Heat Recovery Efficiency" East Tamaki Galvanizing, New Zealand

This entry is in the category of process and environmental innovation now being generated by galvanizers and describes how a process innovation has not only reduced costs but has implications for any industry producing waste heat. It also describes the environmental cleanliness that well justifies the industry's R & D involvement in this well engineered system.

Judges:

Brian Dean, Principal,
Connell Wagner

Terry Wills Cooke, Managing Director,
The Techard Company

DECORATIVE GALVANIZED STEEL
THE IMPACT OF COLOUR

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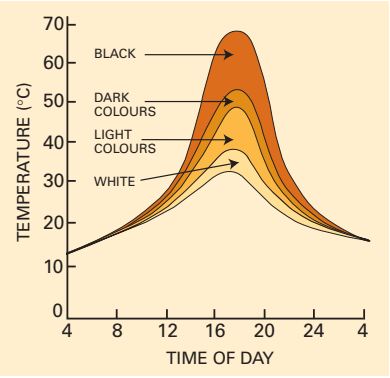

FIGURE 1: Impact of colour on daily temperature of insulated wall surfaces exposed outdoors.

This measure is possible where heat is not absorbed but impacts on the insulated surface.

FIGURE 2: Painted galvanized shed and concrete wall showing marked colour differences using the same paint, due to more rapid chalking because of the higher ambient temperature reached on metal.

Australia's climate is characterised by high ambient temperatures and long hours of sunshine over most of the continent for much of the year. High rates of skin cancer relative to those in most developed world countries would attest to this fact. Indeed, the average maximum shade temperature in January exceeds 30°C over almost all of the continent[1]. Yet shade temperatures are a poor indicator of how hot surfaces exposed to sunlight might react, as the temperature of any material is influenced, among other things, by its mass, specific heat and reflectivity. In terms of reflectivity, colour is an important factor. For example,with a maximum air temperature of 40°C, Martin[2] quotes a flat white roof as reaching 66°C, while a black roof reaches 81°C. This is also well illustrated in Fig. 1 which shows how over the daily range of temperature increases, dark colours increase relative to light colours.

The impact of paint colour on temperature has three important ramifications.

1. White and pastel coloured paints and other light organic coatings will deteriorate slower than darker coloured ones of the same type outdoors, as the reactions which hasten their demise tend to occur faster as the temperature increases.

   In a similar vein, for two surfaces of the same colour, the one with greater mass or higher specific heat will stay cooler. For example, a thin metal wall will get hotter and therefore degrade more quickly than a much thicker material with a high heat sink, such as brick and concrete. The effect will be more apparent if the same colour is applied to different adjacent substrates. In these situations, there is therefore an advantage in painting the metalwork a different colour from the concrete or brick.

2. The hotter the surface, the greater the rate of heat transfers through the building fabric. This means that darker coloured buildings are likely to heat up more quickly than lighter coloured ones. This is particularly true for metal roofs and walls which are comparatively thin and good conductors of heat. For example, for an off-white Colorbond roof exposed to solar radiation at 850 W/m^2*, zero wind speed and 30°C, the manufacturer claims only about 1/8th of the heat is radiated downward, while for an identical tawny brown one about 1/4 of the heat is transmitted.

3. As paints weather, the binder at the exposed surface breaks down to form chalky powder. However, because chalked paint is a light colour, any chalking of a darker or brighter paint is more obvious than with white or pastel colours (Fig. 3).

Therefore, for maximized service life, particularly on thin metal sheeting, the use of bright and dark colours is best limited to areas protected from solar radiation or at least for orientations where solar radiation is less severe, e.g. south and east. While this is not always practicable, the principle of minimising the use of bright and dark colours in direct sunlight, particularly in north and west facing surfaces outdoors, is always worth considering.

One advantage of darker surfaces is that staining and soiling tends to be much less apparent. Thus light painted doors and other frequently trafficked surfaces are less serviceable than dark painted ones in similar situations.

The colour temperature effects described here apply to after-fabrication galvanized steel, to much the same degree as if applied to steel direct.

The same greater severity on thin steel sections will prevail where the galvanizing thickness has no measurable temperature reduction influence.

These factors mean less in more temperate zones but have interesting design implications in tropical and arid high temperature areas where climate is an important factor of the structural and architectural design.

For example, if a hollow section is open ended and vertical, a chimney effect is created and the hollow serves to cool the surface. If it is horizontal or enclosed it will heat up, as the specific heat of air is very low and the heat from the steel will not be absorbed by the hollow. This is one reason why horizontal paint surfaces will degrade faster than vertical ones.

1. "Climatic Atlas of Australia, Australian Bureau of Meteorology, p19
2. K Martin, "Australian Climatic Data and Weathering", JOCCA, p9-15, **4** (1976).
3. JOCCA , p226, **8**, (1983)

*W/m^2 is watts per square metre, ie the amount of heat energy per unit area.

FIGURE 3: Chalking is more obvious on darker and brighter coloured paints

ZINC

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