IMOA®
INTERNATIONAL MOLYBDENUM ASSOCIATION

NEWSLETTER
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# 17th Annual General Meeting

Generously hosted by Jinduicheng Molybdenum Mining Corp, the 17th Annual General Meeting was held in Shanghai in 13-14 September. Mr Gao Dezhu, First Vice-President of the China Non-Ferrous Metals Industry Association and Mr Guan Weigong, Deputy Secretary-General of the Shanghai City Government were kind enough to welcome delegates, some of whom were visiting China for the first time, and guest speakers included:

- **Prof Zhou Shijian, Standing Councillor of China Association of International Trade-** ***"The Present and Outlook for China's Foreign Trade"***
- **Prof Li Cheng, Executive President, Stainless Steel Council of China Special Steel Enterprises Association-** ***"Current Situation of China Stainless Steel Industry and Mo-Containing Stainless Steel"***
- **Dr David Jenkinson, Director Australasia, Nickel Institute-** ***"Molybdenum and Nickel, a Valuable Partnership"***
- **Dr Sun Chang-Ching, China Manager, Outokumpu Asia Pacific Ltd-** ***"Mo-Containing Stainless Steel in China, Yesterday, Today and Tomorrow"***
- **Dr Jiang Lai-Zhu, Chief Research Engineer, Technology Centre, Baosteel-** ***"Molybdenum Alloyed Steel in Baosteel"***
- **Mr Lu Jingyou, Vice-President of Jinduicheng Molybdenum Mining Corp-** ***"China Molybdenum Industry"***
- **Mr Terry Adams, Managing Director of Adams Metals Ltd-** ***"A Review of the Molybdenum Market"***

*Ma Baoping, President of JDC, addresses guests at the Dinner hosted by JDC in the famous Lubolang Restaurant.*

*The outgoing President (right) and incoming Vice-President (left)*

## Election of Officers

At the AGM,
David Thornton, President of Climax Molybdenum Co, was elected President of IMOA in succession to John Graell;
Victor Pérez,
Marketing Director of Codelco, was elected Vice-President

## Membership

Welcome to:

- **Albemarle Corporation,** a consumer of molybdenum for production of refinery and chemical catalysts
- **CM ChemieMetall GmbH Bitterfeld,** a producer of molybdenum metal powders
- **Chaoyang Jinda Molybdenum Co Ltd,** a producer and seller of roasted moly concentrates, roasted moly briquettes and FeMo
- **Commodity Resources Inc,** a trader of molybdenum products
- **Huludao Hongda Moly Co Ltd,** a producer of molybdenum concentrates, molybdenum oxide and FeMo
- **Molymex SA de CV,** a producer of molybdenum oxide

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*Professor Li Cheng and his associate Chen Wenlei*

*Mr Lu Jingyou (Vice-President of JDC) and Nicole Kinsman (IMOA Technical Director)*

John Graell, CEO of Molymet, was completing his fourth year as President, having agreed to stay on after the usual term of 2 years when the orderly line of succession was suddenly broken.

Welcoming around 150 delegates from 70 companies and organisations, Graell recalled that, in 1995, the 7th AGM had been hosted by JDC in Xian, the first capital of China until Kublai Khan transferred to Beijing in the 13 Century. For many who attended, it had been a first visit not only to the centre of the moly industry in China but also to see one of the most spectacular archaeological discoveries ever made (in 1974) – the famous museum of the army of more than 6000 life-size terracotta warriors (all had different expressions, costumes, insignia and weapons) and their horses, constructed by Qin Shi Huang Di, the first Emperor and unifier of China, at the end of the third century BC, to fight for the Emperor as effectively in the next world as their living counterparts had in this one.

Graell pointed out that this time the meeting was being held in the economic centre of China. Shanghai had emerged from the sea 5,000 years ago and its name meant "up from the sea". The city was where many of China's top political leaders cut their teeth and the part played by Shanghai in China's amazing economic growth rate (9.5% in 2004) might readily be witnessed by the many massive construction projects. Graell said that, for IMOA however, the highlights of the city were not the contrasting styles of French and British colonial architecture or historic and modern Chinese, but the shining examples of modern street furniture made of moly-containing 316 stainless steel.

Graell noted that the past year had seen IMOA membership overtake the 50 mark and its budget rise to US$1.5 million; next year, it would be more than US$2 million.
HSE activities occupied more and more of the Association's time and money in a work programme to gather the necessary data to meet existing legislation and be in a position quickly to react to proposed regulations, especially REACH. IMOA's market development programme continued apace, notably on exploring opportunities for Mo containing stainless steel in ABC and Water applications, and the Association always kept very much in mind that it was necessary to defend the moly market against the threats of substitution, as well as unfriendly HSE regulations.

Graell extended a special welcome to new member companies attending their first IMOA meeting and to delegates from other companies who had come to see what IMOA was about, observing that there was no substitute for first-hand experience of a 3-day meeting of representatives from the moly industry worldwide to learn about the benefits of membership.

Graell expressed IMOA's gratitude to guest speakers for taking the time and trouble to prepare presentations for this meeting, when their daily lives were quite busy enough already. Clearly the focus was on China, with an expectation of hearing more about the domestic production and consumption of moly, the end-uses of moly-containing steels and chemicals, and the impact of recent regulations introduced by the Government on the import and export of moly (amongst other metals).

Graell warmly thanked JDC for kindly hosting another AGM. To Mr Ma Baoping, the President of JDC, and to his colleagues involved in helping with the organisation, he expressed his personal gratitude and that of IMOA members and all delegates for their generous hospitality and efficient organisation.

Graell concluded with thanks to members,particularly those serving on Committees, and to staff for their wholehearted support during his extended period of office and asked that the same enthusiastic backing be given to his successor.

# Molybdenum Boosts the Corrosion Performance of Stainless Steel Handrails

*By Gary Cominci, TMR Stainless (Consultants to IMOA)*

## SUMMARY

Attractive appearance, low maintenance requirements, and increased safety have made exterior railings an important growth market for stainless steel. Type 316L stainless steel handrails, which contain 2% molybdenum, are the most cost-effective choice in many environments. Adding molybdenum to stainless steel significantly increases its corrosion resistance in salt (chloride) containing waters. In extremely aggressive coastal applications, where handrails are exposed directly to splashing with high-chloride brackish or sea water, stainless steels with more than 2% molybdenum are necessary to maintain a clean and rust-free appearance.

## THE APPLICATION

The Queens West Park handrails, seating, and lighting components are located on piers adjacent to the East River in New York City. The East River is a narrow, brackish tidal strait that separates Long Island from Manhattan Island. The glass bead-blasted Type 316L has performed extremely well in most of the applications ***(Figures 1 and 2)***. The exception is the splash zone. The splash zone is located where the waves, caused mainly by boat traffic, impinge on the pier wall and frequently splash onto the adjacent handrail section.

***Figure 1.***

The handrails, seating, and lighting components located along the piers adjacent to the East River in New York City were fabricated using glass bead-blasted Type 316L.

***Figure 2.***

The 316L bead-blasted railing components outside of the splash zone have maintained satisfactory corrosion resistance after six years of service.

## THE CORROSION

The cyclic wetting and drying with brackish water produces an aggressive, corrosive environment due to the evaporative concentration of salt and chlorides on the stainless steel handrail. Within a few months after installation, stainless steel components in the splash zone were showing signs of corrosion ***(Figure 3)***. To aid in material selection for the additional stages of this project, Type 316L, AL 2003™, and Type 2205 stainless steel handrail samples with different surface finishes were exposed in the splash zone along the piers for approximately 15 months to assess their corrosion resistance ***(Table 1)***. The effects of both the stainless steel chemical composition and the performance of pickled, sand blasted, and mechanically polished surface finishes were assessed.

| Grade | UNS Number | Molybdenum | Chromium | Nickel | Nitrogen |
|---|---|---|---|---|---|
| 316L | S31603 | 2 | 16 | 10 | - |
| 2003 | S32003 | 2 | 20 | 3 | 0.16 |
| 2205 | S32205 | 3 | 22 | 5 | 0.16 |

***Table 1:*** Typical chemical compositions of stainless steel grades (wt%).

***Figure 3.*** A reddish stain was evident on the 316L railing and panel adjacent to the pier wall, which is frequently splashed by the impinging waves caused by river vessel traffic. The evaporative concentration of salt and chlorides on the surface of the stainless steel results in an aggressive, corrosive environment.

***Figure 4.*** The pickled tube samples after fifteen months exposure in the splash zone displayed uniform, red staining on the 316L (top), light, localized staining on the S32003 (middle), and very limited stain spots on the 2205 (bottom) tube.

## THE SOLUTION

After fifteen months exposure to the East River splash zone, the 2205 handrail samples displayed the best overall corrosion performance when compared to the S32003 and 316L samples ***(Figure 4)***. The 316L samples showed significant levels of surface attack for the polished, pickled, and blasted surface conditions.
The S32003 samples displayed intermediate performance when compared to the 316L and 2205 samples in the pickled and blasted surface conditions. The 316L and S32003 polished samples appeared similar with a uniform stained appearance over the entire railing surface.

Pickling produced the optimum corrosion performance, while sand blasting slightly degraded the corrosion resistance of the samples.
The mechanically polished samples displayed the highest levels of attack and staining when compared to the pickled and blasted surface conditions.

## THE COST SAVINGS

A brackish water splash zone is an aggressive environment due to the high salt (chloride) levels. Stainless steels with higher molybdenum contents are required to maintain a rust-free appearance. Type 2205 stainless steel with 3% molybdenum provides a maintenance cost savings over stainless steels with 2% molybdenum. Type 316L and S32003 would require more frequent cleaning to remove the salt deposits and corrosion stains.

# Chicago's New Type 316 Skyline

*By Catherine Houska, TMR Stainless (Consultants to IMOA)*

Stainless steel's growing popularity as a construction material is changing skylines in major US cities. Many of the newly completed or planned, high profile, North American building projects in trend-setting Chicago and New York are using 2% molybdenum Type 316 stainless steel.

Chicago is currently leading the stainless steel building race. Chicago's new Millennium Park (www.millenniumpark.org/), which opened in July 2004, is the city's new architectural crown jewel. This internationally acclaimed park's most visible construction material is Type 316/316L stainless steel. It was used for the exterior of US architect Frank Gehry's Jay Pritzker Pavilion and BP bridge, British sculptor Anish Kapoor's bean shaped Cloud Gate, and the structural supports for Spanish artist Jaume Plensa's Crown Fountain. The April 2005 issue of *Condé Nast Traveler* included the Millennium Park's BP Bridge and the Cloud Gate in its list of seven new "wonders of the world" making this Type 316 park an important tourist attraction.


***Figure 1:***
Anish Kapoor's Cloud Gate sculpture is also known as the "bean". The underside will remain wrapped until welding and polishing is completed.


***Figure 2:***
Chicago's skyline, Pritzker Pavilion, and the photographer reflected in the Cloud Gate's seamless mirror polished surface.

One of the smaller structures in the park, the 20 m (66 ft) long and 10 m (33 ft) tall Cloud Gate was fabricated from 100 tonnes of 19 mm (0.75 inch) thick mirror polished plate ***(Figure 1)***.
The underside of the bean is not accessible because some seams are still being welded and polished. ***Figure 2*** shows the Chicago skyline reflected on the Cloud Gate's curved surface. IMOA member Outokumpu supplied the plate for this project.

The sweeping Type 316 curves of the Jay Pritzker Pavilion band shell and one end of the BP Bridge can be seen in ***Figures 3 and 4***. The faces of 1,000 Chicago citizens are projected on the facing glass block walls of the Crown Fountain's towers ***(Figure 5)***.

The glass block is held in place by Type 316 structural supports. The Type 316 tonnage used for the pavilion, bridge and fountain is not known but it is assumed to be significant.

***Figure 3:***
The sweeping Type 316 exterior walls of the Jay Pritzker Pavilion band shell and the structural supports for the sound system spanning over the concert lawn.

Chicago's recent high-profile use of Type 316 does not stop at the borders of Millennium Park. In 2005, two new adjoining Outokumpu Type 316L clad buildings were completed on South Wacker Drive. 111 South Wacker Drive was designed by Lohan Caprile Goettsch (Chicago) and Hyatt Center ***(Figure 6***) was designed by Pei Cobb Freed & Partners (New York). These buildings are clad in about 400 tonnes of Type 316L stainless steel. The highly publicized, new Trump Tower, which is under construction, was designed by Skidmore Owings & Merrill (Chicago) and will use about 170 tonnes of Type 316 on the exterior.

***Figure 4:***
Both ends of the BP Bridge have a serpentine shape. The entire structure is clad in Type 316 stainless steel. The bottom floors of the Blue Cross Building, which is directly behind the bridge, are clad in Type 316 to prevent deicing salt corrosion.

Several important Type 316 buildings exteriors were recently bid in New York. Goldman Sachs' new Pei Cobb Freed designed world headquarters will use about 430 tonnes of Type 316L, and Sir Norman Foster's 610 Lexington Avenue design will use about 300 tonnes of Type 316L. 7 World Trade Center, which used both Type 316 austenitic and 2205 duplex stainless steel, is nearing completion. Freedom Tower (Skidmore Owings & Merrill, New York office), which will replace the World Trade Center towers, is expected to be clad in Type 316.

Although the tonnage of stainless steel that has been or will be used for most of Millennium Park, 7 World Trade Center, and Freedom Tower is not known, about 1,400 tonnes of Type 316/316L or 28 tonnes of molybdenum have been or will be used for the other projects mentioned in this article. It is important to note that only very high profile buildings were included in this article. Many Type 316 railings, storefronts, canopies, and similar applications are specified daily in these cities.

Because New York and Chicago have the largest concentrations of architects in North America, IMOA has made them primary focus areas for market education and development efforts. In a 2005 IMOA-sponsored market study, contractors and architects indicated that the first tier architecture firms in these cities are now consistently specifying Type 316 for exterior applications. The use of stainless steel in exterior applications has increased significantly in these cities in the past five years. IMOA workshops and literature were cited by respondents of the survey as the reason for increased specification of Type 316 by architects.

*Photo credits:*
*All of the images were taken by or for IMOA.*


***Figure 5:***
The faces of 1,000 Chicago citizens are projected on the glass block faces of the Crown Fountain. The structural supports for the fountain are Type 316 stainless steel.


***Figure 6***:
The exterior of the new Hyatt Center is Type 316 stainless steel.

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