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A. WELDING RESEARCH AND DEVELOPMENT IN JAPAN

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The author spent a one year sabbatical in Tokyo surveying welding and materials processing technology in Japan) Although the tour of duty included a month of visits to Korea, Australia and China, the bulk of the liaison work was done in Japan. Universities visted included: Tokyo University, Osaka University, Nagoya University, Kyoto University, Tohoku University, Kyushu Institute of Technology, Tokyo Institute of Technology, Nippon Technical University, Tokyo Science University, and Nippon University.

Government laboratories visited included: Nippon Telephone and Telegraph, National Research Institute for Metals, Electrotechnical Laboratory, Ship Research Institute, and the Mechanical Engineering Laboratory.

Industry visits included: Kobe Steel, Nippon Steel, IHI, Hitachi, NKK, Kawasaki Steel, Kawasaki Heavy Industries, Hitachi Shipbuilding, NKK Shipbuilding, Mitsubishi Heavy Industries, Sumitomo, Osaka Transformer, Matsushita, and Toshiba.

Eighty percent of the time spent on these visits was on technical discussion, not just plant tours; hence, a fairly in-depth and forward looking picture of Japanese welding research has been obtained.

These visits are in the process of being published in the Scientific Bulletin of the Office of Naval Research (ONR) Tokyo office. Titles which have been published and others which are not yet published include:

- Welding Research and Education at Osaka University.
- Electroslag Technology in Japan.
- Cooperative Research and Technology Transfer in Japan.
- Electron Beam and Laser Materials Processing in Japan.
- Ceramic/Metal Bonding Research in Japan.

Major trends ~~which I see~~ in Japan include:

1. A move away from the extensive work in heavy section electron beam welding.

2. A decrease in arc welding development due to the lagging heavy industry business.

3. Increased materials processing research by welding laboratories.

4. Greatly expanded laser processing research and some new applications; as well as three Japanese suppliers of 5 kilowatt CO₂ laser systems.

5. Great interest in ceramic/metal bonding.)

Example

Osaka University is believed by many to be stronger than Tokyo University in individual programs in a number of areas, including engineering departments. One of its unique programs is the Department of Welding Engineering and associated Welding Research Institute.

Osaka University's Department of Welding Engineering is analgous to Ohio State University's Department of Welding Engineering. However, the department at Osaka University dominates the welding community in Japan much more so than does the Ohio State department. One reason is its total faculty and professional staff of 60 that gives Isaka University one of the greatest concentrations of welding researchers in the world. Moreover, Osaka University's department of welding engineering as organized by the Ministry of Education of the Japanese government is the sole educational center for welding in Japan.

The Osaka University department has eight "kozas" or chairs wherein each koza was established by the Ministry of Education to develop expertise and continuity in specific areas; these include:

1. Welding physics, i.e., laser materials processing, arc physics, solid state welding, and plasma spraying, with diffusion welding and plasma spraying of ceramics and metals in early stages of development.

2. Welding metallurgy, including studies of crack susceptibility and toughness improvements in steels.

3. Welding mechanics, with work under way on design procedures for reducing residual stresses and distortion.

4. Welding equipment, including computer-aided manufacturing systems to monitor the welding process.

5. Welding design with emphasis on fatigue and stress corrosion cracking studies.

6. Materials science for welding with research on hydrogen cracking and acoustic emission monitoring of hot and cold cracks.