# TUESDAY, AUGUST 23, 2005, P.M.

## SESSION 25: INTERNATIONAL SYMPOSIUM ON LIGHT METALS

ALUMINIUM FABRICATION AND PROCESSES
Sponsor(s): Light Metals Section, The Metallurgical Society of CIM
Room: Neilson 1
Chair(s): R. GUTHRIE, McGill University, Canada, and
M. WELLS, University of British Columbia, Canada

PAPER 25.1—14:00
MICROSTRUCTURAL EVOLUTION IN AA6111 ALUMINIUM DURING COLD WORK AND AGING.
G.K. QUAINOO and S. YANNACOPOULOS, University of Saskatchewan, Canada
In the automotive industry, the awareness to meet Corporate Average Fuel Efficiency (CAFE) standards has evolved the need to reduce vehicular weight in new automobile designs, with the overall goal of reducing gas emissions into the atmosphere (Kyoto protocol). One efficient method has been to use lighter materials such as aluminum in outer body panels. Heat treatable AA6111 is one of the materials employed due to its unique combination of formability, paint bake strengthening and superior corrosion resistance characteristics. Researchers have applied various thermo-mechanical processes on 6000 series aluminum alloys and have found an improvement in the mechanical properties of these alloys. For a formed and painted automobile panel, the final mechanical properties involve a combination of strength components arising from cold work, strain aging and precipitation minus recovery. In this study, the evolution of microstructure resulting from the interaction of cold work and precipitation in AA6111 has been studied by means of transmission electron microscopy (TEM) after subjecting samples to various heat treatments, tensile testing and differential scanning calorimetry (DSC). This has been done to understand the evolution of microstructure and its influence on the properties of the alloy. The results show a considerable improvement in strength with a corresponding increase in strengthening precipitates with increasing level of cold work in the alloy. DSC results following the application of various levels of cold work also show acceleration in the precipitate phase formation, as precipitates are observed to form at lower temperatures, with increasing level of cold work.

PAPER 25.2—14:25
MODELING OF AGE HARDENING FOR TWO VARIANTS OF ALMGSI(CU) ALLOYS.
S. ESMAEILI, University of Waterloo, Canada and
D.J. LLOYD, Alcan International Ltd., Canada
The yield strength model developed by Esmaeili, Lloyd and Poole [1] has been adapted to model isothermal aging in Cu-containing AA6xxx alloys, with (a) a moderate and (b) a very low Cu content in the solution-treated, as-quenched, condition. Isothermal calorimetry has been used to analyze the kinetics of precipitation in these alloys. While the kinetic parameters for the low Cu alloy has been derived from the present experiments, the previously determined kinetic parameters for the high Cu alloy AA6111 has been used to model the precipitation kinetics in the moderate Cu alloy. The age hardening responses of both alloys have been well predicted by the model.

PAPER 25.3—14:50
EXTRUSION OF TUBES AND HOLLOW SHAPES FROM ALUMINUM ALLOYS.
D.S. SALONINE and H.J. MCQUEEN, Concordia University, Canada
Aluminum alloys are widely used in modern industry. Tubes and hollow shapes give great opportunities for structural purposes as well as fluid transport due to their stiffness and lightness. Extrusions on a mandrel or through a bridge die, that requires splitting of the billet with re-welding, produce hollow shapes with varied contours, fins and multiple cavities. Moving and stationary mandrels, mandrel lubrication, tooling for ribbed-tube heat exchangers, and for drilling pipes are considered. Bridge dies can be classified by the bridge position relative to the die face, by mandrel support structure, and by assembly type. The main parameters influencing the quality of the die-welded seams are considered. The difficulties of extruding various alloys through bridge dies are discussed in terms of metallurgical factors. Some approaches to the calculation of the stresses in a bridge are presented.

COFFEE BREAK—15:15-15:45

PAPER 25.4—15:45
A NEW SOFTWARE (MATROLL) TO DETERMINE THE COEFFICIENT OF FRICTION AND TO PLOT THE FRICTION HILL DURING THE COLD ROLLING OF ALUMINIUM.
K. DEHGHANI and H. ABDOLLAHI, Amirkabir University, Iran

Cold rolling is one of the most important techniques in metal forming since the cold rolling products are almost finished product. The product quality of this process is widely influenced by friction in the roll gap; therefore, controlling the friction and other parameters affecting the cold rolling is very important in order to have a product with high quality. Among the cold rolling parameters, the pressure distribution or friction hill within the roll gap is known as the most significant one. In this study, a new software (Matroll), is introduced which can determine the coefficient of friction (COF) and plot the friction hills for an industrial mill. Besides, based on rolling equations, it offers about 25 rolling parameters as outputs. To verify the software operation, the real industrial rolling data was used as inputs. The results (outputs) are in good agreements with the findings of other researchers. The COF values are very reasonable. The friction hill shows that COF is not constant over the whole arc of contact.

PAPER 25.5—16:10

ENHANCEMENT OF MECHANICAL PROPERTIES IN HEAT AFFECTED ZONE OF AA 5083 WELD JOINTS: POTENTIAL AND INTERPRETATION.

W.U. MIRIHANAGE and N. MUNASINGHE, University of Moratuwa, Sri Lanka

Considerable mechanical property decline is always observed at the Heat Affected Zone (HAZ) of AA 5083. This occurred as a result of the thermal effect on the hardened material. It is highly beneficial to have a prospective metallurgical procedure to overcome this decline of properties. Therefore, experiments were set to evaluate the effectiveness of a quick post weld heat treatment process with the AA 5083. Optimum results were obtained at 473K and with approximately 600 seconds time. The interplay between the time, temperature and mechanical properties are possible to explain by the Lifshitz-Slyozov-Wagner (LSW) theory and by considering the composition of the material.