TUESDAY, AUGUST 23, 2005, P.M.

SESSION 30: INTERNATIONAL SYMPOSIUM ON PIPELINES FOR THE 21ST CENTURY IN HONOR OF DOUG BOYD

PROCESSING AND PROPERTIES III — PROPERTY EVALUATION AND SPECIFICATIONS
Sponsor: Iron and Steel Section, The Metallurgical Society of CIM
Room: Imperial Ballroom 1
Chairmen: S. YUE, McGill University, Canada and
W.R. TYSON, CANMET, Canada

PAPER 30.1 — 14:00 (KEYNOTE)
THE EVOLUTION OF MATERIALS FOR PIPELINE APPLICATIONS.
D. EMBURY, McMaster University, Canada

The construction and utilization of oil and gas pipelines is a vital aspect of the Canadian economy. The evolution of materials for this application can be considered as part of an evolutionary process in which the processing of the materials is linked to the design requirements of the pipeline. The evolution of both materials and designs will be considered in terms of parameters such as yield strength, work hardening characteristics including strain path changes such as the Bauschinger Effect and toughness. The final portion of the presentation will consider the possible uses of non-metallic materials, composites and 'smart 'systems in pipeline construction.

PAPER 30.2 — 14:35
MEASUREMENT OF CTOD USING AREA OF LOAD/PLASTIC CMOD FOR SE(T) SAMPLES.
G. SHEN and W.R. TYSON, CANMET, Canada

In most fracture toughness test standards, such as ASTM E 1290 and BS 7448, crack-tip opening displacement (CTOD) is measured by using three-point bend (SE(B)) or compact (C(T)) samples with deep cracks. The loading mode and crack depth in these tests sometimes are different from that of pipelines. Pipelines usually have shallow defects and experience tensile loading when the supporting ground moves. As a result, the CTOD measured by these samples is lower than that of pipeline in tension. Recent researches suggest using single-edge-notch tension (SE(T)) samples to measure fracture toughness for pipelines. In the present study, shallow and deep SE(T) samples under fixed grip loading were analyzed by using the finite element technique. An equation to relate the CTOD to the area of the load/plastic crack mouth opening displacement (CMOD) is proposed. With this equation, the CTOD of a SE(T) sample can be evaluated by measuring the area under the load/plastic CMOD curve of a SE(T) sample.

PAPER 30.3 — 15:00
TOUGHNESS: ITS MEASUREMENT AND RELEVANCE FOR PIPELINES.
W.R. TYSON, CANMET, Canada

Pipelines for the transport of gas and oil are being designed to operate at increasing pressures in increasingly harsh environments. The steel used to construct these pipelines must have adequate toughness to tolerate weld imperfections (i.e. withstand bending strains) and to arrest running cracks (i.e. to prevent propagation of axial fractures). The problems posed in specifying suitable toughness parameters and the approaches currently being used to measure them are discussed.

COFFEE BREAK — 15:25 – 15:45

PAPER 30.4 — 15:45
QUANTIFICATION OF PRECIPITATES IN MICROALLOYED STEELS.
J. LU, H. HENEIN and D.G. IVEY, University of Alberta, Canada

Microalloyed steels are widely used in the oil and gas industry. They are a class of high strength, low carbon steels containing small additions of niobium (Nb), titanium (Ti), molybdenum (Mo) and/or vanadium (V). These steels have good strength, toughness and excellent weldability, which are attributed in part to the presence of nano-sized carbides, nitrides and carbonitrides. In the pursuit of developing higher strength microalloyed steels, it is of great interest to quantify the size, distribution, volume fraction and chemical speciation of these precipitates. However, characterization techniques suitable for quantifying fine precipitates are limited. Possible characterization techniques include SEM, TEM and matrix dissolution. A comparison is presented of the various techniques.

PAPER 30.5 — 16:10

MICROSTRUCTURE AND PROPERTIES OF PLATES FOR LINE PIPE STEELS FOR ONSHORE AND OFFSHORE APPLICATION.

J. BAUER, N. CAUDERLIER, P. FLUESS and V. SCHWINN, AG der Dillinger Hüttenwerke, Germany

From a strategic and economic point of view, the development of fine grain high strength steels for long distance pipelines is intensified world wide to satisfy the demand for natural gas in the future.

The project related property profiles based on strength, toughness, crack arrest and sometimes resistance against HIC at defined design temperatures require an effective structural refinement using advanced steelmaking and processing in the rolling mill.

The microstructure of modern line pipe steels ranges from ferritic pearlitic to ferritic-bainitic and structures where bainite is the dominant component, possibly upgraded by secondary phases.

This paper illustrates microstructures and properties of recent orders on line pipe steels both for onshore and offshore application using different processing routes in the plate mill.

Examples will be given for SAWL 485 offshore grades, X65 HIC and X70 HIC onshore grades, respectively. Finally, production results of a recent X80 order will be presented.

PAPER 30.6 — 16:35

APPLICATION OF CARBON EXTRACTION REPLICAS IN THE MICROSTRUCTURAL ANALYSIS OF HIGH STRENGTH MICROALLOYED STEELS.

K. POORHAYDARI, B.M. PATCHETT and D.G. IVEY, University of Alberta, Canada

In this paper, some applications of carbon extraction replicas, as samples for transmission electron microscopy (TEM), are discussed. Modern high strength microalloyed (HSMA) steels, used as structural or pipeline materials, have very small grains with substructures. Replicas used in TEM can resolve the grain boundaries and can be used for grain size measurements in cases where the small size of the grains pushes the resolution of conventional optical microscopes. The grain size variations obtained from replicas correlated very well with mechanical property variations, indicated by hardness, in the fine-grained heat-affected zone and base metal of some welded HSMA steels. Replicas are also very suitable samples for precipitate examination with analytical TEM. Advantages and limitations of the application of replicas, as well as some corrections for the estimation of the volume fraction of fine precipitates, are discussed.