MPM Technologies, Inc.

Miniaturized Charpy V-Notch Test

INTRODUCTION

Surveillance programs in the nuclear industry are implemented by most utilities to monitor the embrittlement of the reactor pressure vessel (RPV). These programs rely on surveillance capsules which contain Charpy V-notch (CVN) and tensile specimens. The results of the CVN tests are very important to the plant owners because these data are used to calculate the allowable pressure loading of the vessel as a function of the downcomer coolant temperature (P-T curves). In fact, the P-T curves shift to higher temperatures degree for degree as the Charpy energy-temperature curve shifts. Some plants have experienced larger upward shifts of the Charpy energy-temperature curve than originally anticipated before plant operation. Other plants only have one or two surveillance capsules remaining and additional capsule data are needed to verify embrittlement trends. Therefore, there is an ever-increasing need to obtain more Charpy data as plants age.

A similar need exists in the fossil power industry to characterize creep damage in piping and vessels. In high temperature applications, it is often feasible to extract material (boat samples) from in-service components for metallography and mechanical testing. The MCVN test provides 8 MCVN specimens from the volume of one conventional Charpy specimen. Therefore, the MCVN test provides the opportunity to obtain a statistically significant amount of Charpy data from one boat sample.

The MCVN test was invented to fulfill the need for more surveillance data within the power industry. A Phase I study to demonstrate the feasibility of developing a MCVN test has been completed. The Phase I study resulted in an optimized miniaturized specimen geometry which is fully capable of measuring notched impact data with accuracy equal to that obtained using conventional test specimens. Based on the success of the Phase I work, a Phase II program was conducted to develop an advanced CVN and MCVN impact test system. During the Phase II work, the striker design was improved, research was performed to explain differences between the energy measured using the dial as compared to the instrumented striker, an in-situ heating and cooling system was perfected, a specimen alignment system was developed, and ASTM standard test procedures were written and balloted. The advanced test system developed is now ready for full demonstration by testing a variety of RPV materials in a third and final phase of development. This work, in addition to the continuing standards development work, will lead to ASTM acceptance and standards which can be referenced by regulatory bodies.

2161 Sandy Drive
Office (814) 234-8860
State College, PA 16803-2283
FAX (814) 234-0248
www.MPMTechnologies.com
USA

During the performance of the Phase II work, a feasibility study was conducted to determine whether fracture toughness data can be obtained from the instrumented impact signal. It was discovered that plane strain conditions are present in the Charpy specimen over most of the transition region. This fact, along with the improvements in load measurement during the impact test, provides an opportunity to obtain fracture toughness directly. This new approach has the advantage that the current conservatism associated with using Charpy data to predict the ASME reference toughness shift can be eliminated since it will be possible to measure the reference toughness curve directly. In the future, utilities can have both Charpy data and fracture toughness data for use in preparing P-T curves.

FOR MORE INFORMATION

If you would like a price quotation or additional information concerning MPM's services or products, please contact us at the below listed address:

Address:	**MPM Technologies, Inc.** 2161 Sandy Drive State College, PA 16803
Individual:	Dr. Michael P. Manahan, Sr.
Phone:	814-234-8860 (extension 121)
FAX:	814-234-0248
Website:	www.MPMTechnologies.com
Email:	MPManahan@MPMTechnologies.com