

THE WELDABILITY OF VANADIUM-MICROALLOYED STEELS

By

P H M Hart, Technology Group Manager, TWI Limited,
Granta Park, Great Abington, Cambridge CB1 6AL

1. INTRODUCTION

The development of microalloyed steels began approximately half a century ago with the initial drivers of reducing material costs and increasing strength. Although improved weldability was not amongst these very first incentives for the development of microalloyed steels the opportunities that microalloying gives for improving weldability by reducing carbon content was fairly quickly recognised and became another major driving force for their development and understanding. However, it was not until possibly the first major international conference on these steels, MA75, that a substantial public hearing of the topic occurred. In this paper the aim will be to focus attention on the current information concerning weldability aspects related to vanadium-microalloyed steels for structural, pressure vessel and linepipe applications and will consider the relevant weldability aspects of solidification cracking, hydrogen cracking during fabrication, HAZ hardening, and HAZ and weld metal toughness. Some consideration will also be given to the role of vanadium in beneficially influencing microstructural development, particularly during welding that has become increasingly recognised in recent years.

2. WELDABILITY TOPICS

2.1 Solidification Cracking

Past experience has certainly shown that in relation to arc welding the benefits that microalloying additions can bring to steel composition in terms of a reduction in carbon content, have been overwhelmingly beneficial. A systematic study of the influence of compositional variables on solidification cracking was carried out some years ago by TWI (1) and the results incorporated into British and now European Standards for arc welding of ferritic steels. The work was done using submerged arc welding which usually involves considerable dilution of the parent steel and therefore allowed compositional effects of parent steels to be evaluated. A formula was devised which relates crack susceptibility, in terms of units of crack susceptibility, (UCS) to the composition of the weld metal and is:

$$UCS = 230C + 190S + 75P + 45Nb - 12.3Si - 5.4Mn - 1.$$