Hardenability Test Simulator

The Jominy Test involves heating a test piece from the steel (25mm diameter and 100mm long) to an austenitising temperature and quenching from one end with a controlled and standardized jet of water.
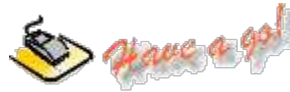
Take a sample from the furnace and place it on the Jominy test fixtures and observe the cooling pattern.

After quenching the hardness profile is measured at intervals from the quenched end after the surface has been ground back to remove any effects of decarburisation (0.38mm is removed from the surface).

The hardness variation along the test surface is a result of microstructural variation which arises since the cooling rate decreases with distance from the quenched end. The cooling rate along the Jominy test specimen varies from about 225 °C s^{-1} to 2 °C s^{-1}.

Simulation

1. Open the web page simulation above.
2. In this simulation, you can perform a series of Jominy end quench tests on different grades of steel to see how composition affects hardenability. These steels include:
   - 0.2% Carbon ©; 0.8% Manganese (Mn)
   - 0.31% C; 0.8% Mn
   - 0.49% C; 0.8% Mn
   - 0.31% C; 0.8% Mn; 0.5% Nickel (Ni); 0.5% Chromium (Cr); 0.2% Molybdenum (Mo)
   - 0.31% C; 0.8% Mn0.5% Ni; 0.5% Cr; 0.2% Mo; 0.002% Boron (B)

   A bit later, you can select which grade of steel you wish to investigate first. Do all steels. (Stage 0)
3. Make note of the specimen size (Stage 1)
4. Select which steel you wish to investigate (drop down selection at top of simulator), and then drag the sample into the austenizing furnace. Wait for it to fully heat up. (Stage 2)
5. Drag specimen into the quench device. Wait for it to fully cool. (Stage 3)
6. Perform hardness tests on sample (Stage 4). Starting with the first indent at the bottom of the bar, move from indent to indent by using the slide on the right hand side. With the red line centered on the diamond indent, note the distance from the end and measure the length across the diamond by sliding the mouse in from the side to touch both ends of the diamond. Record hardness data presented.
7. Insert data for the materials tested into the data input. The first indent from the bottom is at 1.6 mm, the second is at 3.0 mm, the third indent up is at 5.0 mm, etc. (Stage 5)

d / mm	Hardness / HV30	d / mm	Hardness / HV30
1.6		15.0	
3.0		20.0	
5.0		25.0	
7.0		30.0	
9.0		35.0	
11.0		40.0	
13.0		45.0	

8. Repeat the procedure for each of the five steels.
9. Print out the graph with the cumulative hardenability curves for all five steels (Stage 6)

Analysis

Which steel would you select for the tank production?

Will this steel have enough strength to hold the propane pressure?

Is there anything we can do with the welding procedure to assure that a minimum of the hard brittle martensite is not formed?