WEAR PROPERTIES OF ADI AND CADI

Wear properties of ADI and CADI have been tested in the following modes:

- Pin Abrasion ASTM G132-96(2001)
- Wet Sand / Rubber Wheel (WSRW) ASTM G105-02
- Dry Sand / Rubber Wheel (DSRW) ASTM G65-00

The pin abrasion test is a high stress abrasion environment while the wet sand and dry sand rubber wheel tests simulate low stress environments.

Wear properties of austempered cast irons are of interest because of the ability of the matrix material (ausferrite) to harden in service. **Figure 1** illustrates the increase in surface hardness due to the strain-induced transformation of austenite to martensite when a sufficiently high normal force is applied.

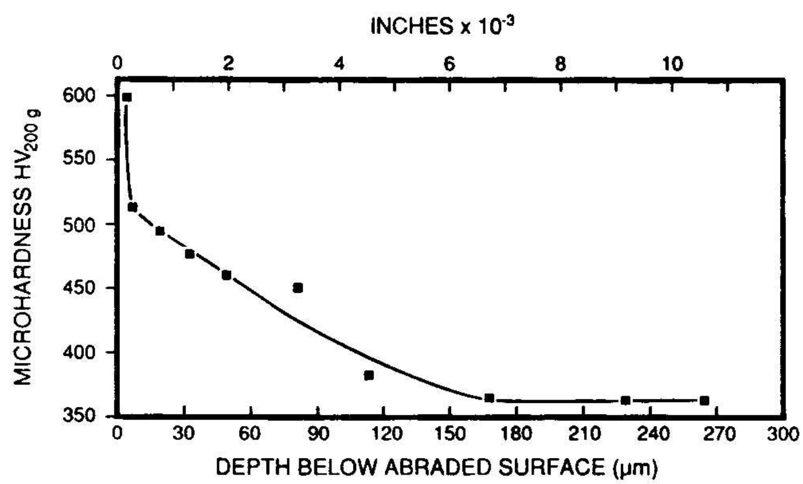

Fig. 1. Microhardness as a function of depth for an abraded surface of ADI. [From Ductile Iron Data for Design Engineers.]

RESULTS

Pin abrasion test (high stress environment) results are shown in **Figure 2** for a number of cast irons, austempered ductile irons, steel and abrasion resistant irons. Several observations can be made from this data:

- The curves for austempered irons are relatively flat, indicating that the material loss is insensitive to hardness. This is a result of the austenite to martensite transformation on the surface of the test piece.

- In a high stress abrasion environment, ADI, CADI, Ni-Hard Grade 2 and abrasion resistant (AR) irons have better abrasion resistance than austempered and Q&T steel.

- The abrasion resistance of ADI can be further improved by the addition of carbides or using CADI. The volume of material lost is dependent on the volume fraction of carbide present, with higher carbide volumes resulting in better abrasion resistance.

- The best abrasion resistance is exhibited by the AR irons. However, CADI and Q&T ductile iron can rival the performance of some of these irons.

Wet sand/rubber wheel (low stress environment) results are shown in **Figure 3** for austempered ductile irons and competitive steels. Because the data overlaps in some instances, only the regressions lines for each data set are present in this figure. Dry sand/rubber wheel (low stress environment) results are shown in **Figure 4**.

Observations from **Figures 3** and **4** include:

- The curves for the austempered irons have a steeper slope than those from the pin abrasion testing. This likely occurs because the normal forces applied in the WSRW and DSRW testing were insufficient to initiate the austenite to martensite transformation.

- In these testing modes, the abrasion resistance is dependent on the bulk hardness of the material.

- The abrasion resistance of ADI can be improved by the addition of carbides i.e. CADI, with the higher carbide volumes exhibiting lower material loss.

It should be noted that the relative magnitudes of the volume loss for WSRW and DSRW testing are different in **Figures 3** and **4**. This occurs because the hardness of the rubber wheels that are utilized for DSRW and WSRW testing is different, depending on the test method. A harder rubber wheel was used for the DSRW testing, hence the reporting of larger volume losses. As a result, readers are cautioned to use this data to compare materials tested within the same mode, but not compare the volume losses from one test method to another.

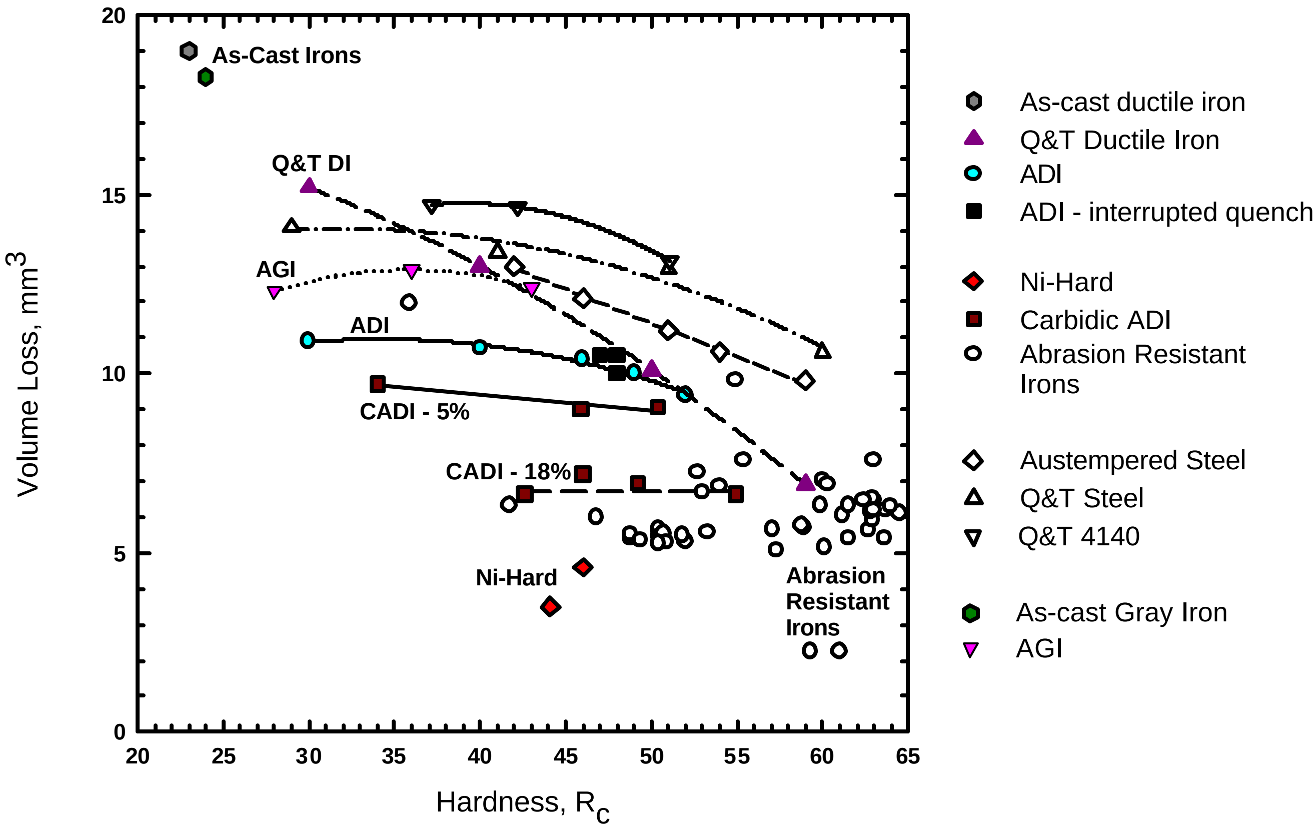

Fig. 2. Pin Abrasion Data for various cast irons, austempered ductile irons, steel and abrasion resistant irons. Abrasion resistant iron data from the Abrasion – Resistant Cast Iron Handbook.

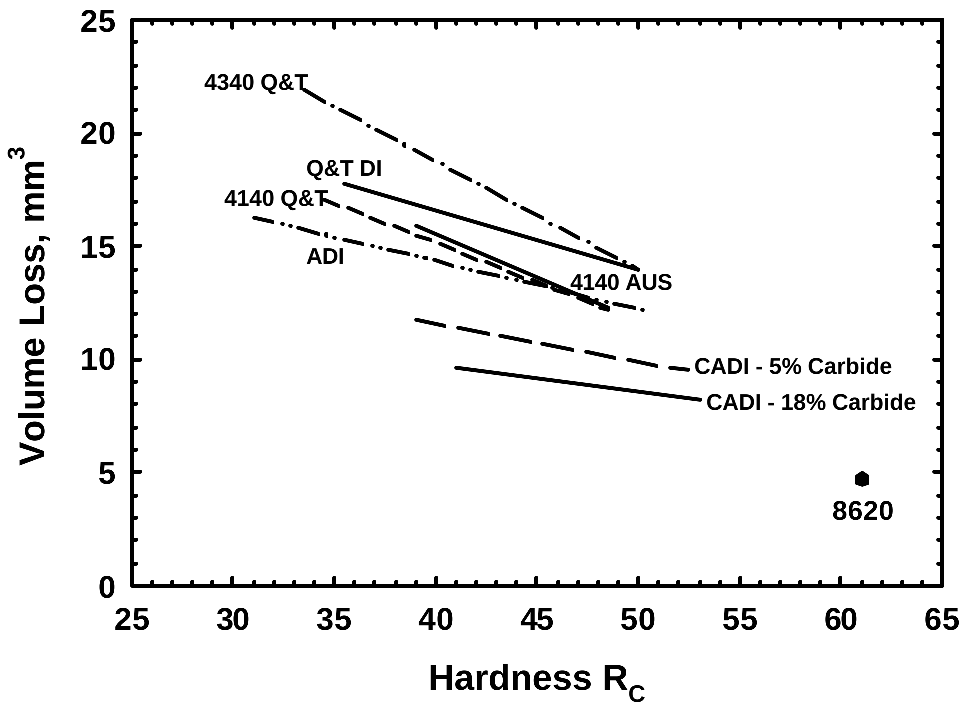

Fig. 3. Wet Sand/Rubber Wheel Abrasion results for various ductile iron, austempered ductile irons and steel.

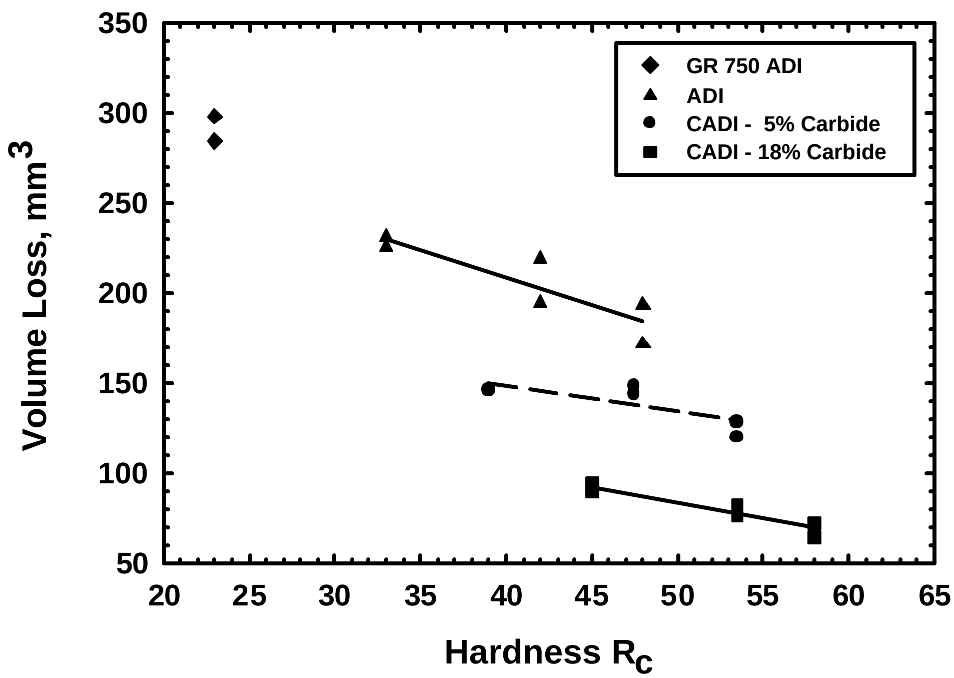

Fig.4. Dry Sand/Rubber Wheel Abrasion results for various austempered ductile irons.