CATEGORY: ROLL INSPECTION

TYPE: HARDNESS TESTING

Hardness testing is the most commonly applied method of inspection applied to rolls. Hardness testing can be broken down into two primary categories namely that of indentation and rebound methods. It is a common misconception that hardness testing alone can predict that performance of the roll material, when in reality, a thorough understanding of the roll material microstructure, physical/mechanical properties as well as hardness that determines the overall performance that can be expected of the material. This section will therefore provide a basic understanding of each hardness test method in terms of how it works and how to interpret the results. Despite its short comings, hardness testing is still a simple, easily applied test inspection method for determination of roll quality and consistency.

The typical specifications for roll hardness provided to manufacturers are in one of the following scales:

- Equotip (HLd/HLe)
- Shore (HSd/HSc)
- Rockwell (HRc)
- Vickers (HV/HV30)

These scales can be divided into two groups based on the method of measuring the hardness:

- Indentation
    - Rockwell and Vickers
- Rebound
    - Equotip and Shore

Each type of hardness measurement method (indentation/rebound) provides a result which can be strongly influenced by different aspects of the roll microstructure. The results obtained by the different methods can therefore be unreliable or lead to discrepancies when attempting to relate one test method to another.

<u>Indentation Methods</u>

The indentation method of hardness testing relies on a ball or pyramidal diamond that is impressed into the material under a given calibrated load. The material being tested will therefore deform away from the indenter by varying amounts depending on the resistance of the material to deformation. The residual indentation is then measured by either its depth (Rockwell) or size (Vickers) and related back to a known scale for determination of a quantifiable hardness result.

This test method is predominantly dependant on the mechanical deformation resistance of the matrix structure and is largely independent of the volume and type and carbides present.

Advantages:

- This test method is a direct measurement of a roll materials resistance to marking
- Not influenced by the surface cleanliness of the area being tested (oil, grease, etc).
- Lower variation and greater repeatability of results

Disadvantages:

- Very time consuming
- Equipment is cumbersome and difficult to use in a roll shop environment
- As carbide type and volume has little influence, this is not a very good method for determination of outright wear performance of the roll material
- Residual indentations from the test typically are of a depth that requires removal prior to mill service

Rebound Methods

This test method uses a small carbide or diamond ball which is propelled at the test surface at a specific speed (under free fall for Shore and spring assisted for Equotip). The hardness result is then determined based on specific aspects of the rebound of the ball from the test surface. In the Shore system, it is the height achieved by the ball in a glass tube relative to the height that the ball was released at. Equotip systems measure the voltage induced in a coil as the ball passes through it in its impact and rebound phases.

These test methods are more strongly influenced by all constituents of the roll microstructure (including carbide type and volume) as well as residual stress than indentation method (Rockwell and Vickers).

Advantages:

- Fast, easy test to perform
- Equotip is the most common test method used in roll shops throughout the world
- More representative level of outright roll performance as carbide type and volume have an effect on the indicated results

Disadvantages:

- Strongly influenced by surface preparation and cleanliness
- Shore is not a direct test method in widespread use anymore. Even though the Shore scale is widely specified and quoted.
- Greater variability between individual test results. Averaging of three or more results is required in order to obtain an accurate assessment.

Specification Of Roll Hardness

Due to the inherent differences in the factors that influence the hardness test methods, it is strongly advised that roll specifications provided by the user be in the same method/scale as that which is used in the roll shop for hardness testing. For example, if the roll is to be tested by the user using an Equptip device, it is strongly advised that the roll be specified to the roll manufacturer in the same Equotip scale. This will insure that any inherent error that may occur between different test methods will be removed.