

Wear and materials

Wear parts application guide







Wear parts application guide - Wear and materials

Wear

Wear is material loss on surface by means of several different mechanisms.

The two main wearing mechanisms in crusher cavity are:

- Abrasive wear
- Fatigue wear

The main wearing mechanism in crusher cavity is abrasive wearing. Fatigue wear is also present as wear part are subjected to multiple compression or impact loads.

Abrasive wear (or abrasion)

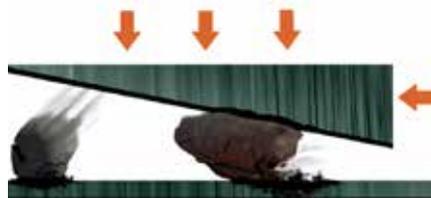
Crushers typically compress the feed material between the fixed and movable wear parts. Besides the breakage of the feed material, this is also wearing material away from the wear part. Wearing micromechanisms are:

- Microploughing
- Microcutting
- Microcracking
- Microfatigue

During the crushing cycle, gouging or high stress abrasion is present depending on the particle size of feed material. Between the crushing cycles when particles of feed material are sliding against wear parts, low stress abrasion is present.

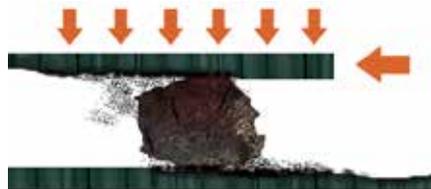
Gouging abrasion

- Large particles
- High impact or compression loads
- Good work hardening on manganese



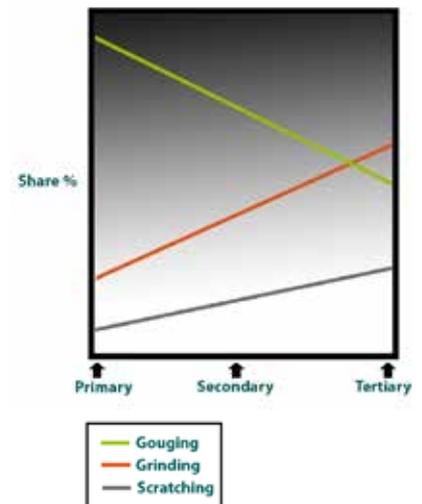
High stress or grinding abrasion

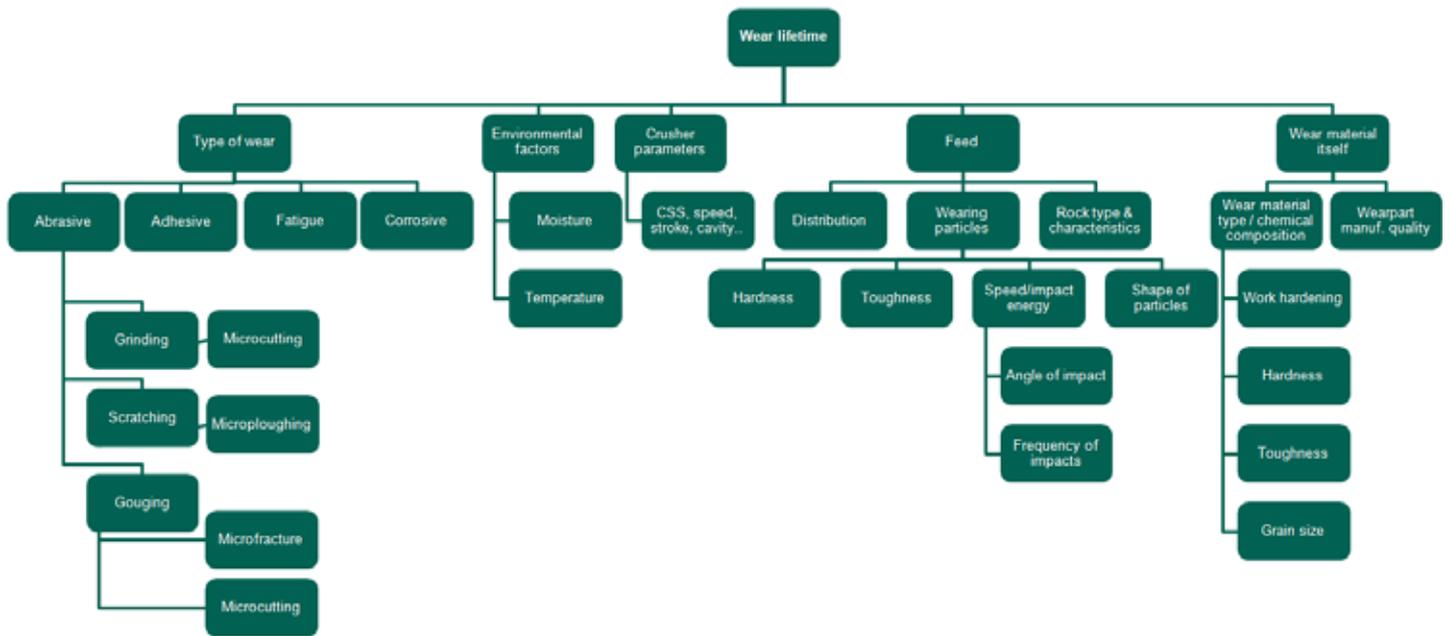
- Smaller particles
- High compression load
- Less work hardening on manganese



Low stress or scratching abrasion

- No compression load
- Scratching abrasion while material is sliding at the surface of wear part
- Less work hardening on manganese





Several different factors affect the wear of wear parts. Type of wear, environmental factors, crusher operating parameters, feed material and wear part properties are just a few of these.

However, one of the the most notable factor in the wear of crusher wear parts is the abrasiveness of feed material.

The abrasiveness of the feed material can be determined at Metso's rock laboratory using a test for abrasiveness. The following table indicates the abrasiveness of rock based on this test.

Crushability of the rock can be determined with the same equipment used to identify abrasiveness. Crushability indicates how easily the rock material breaks down. Difficult rock with a low crushability value requires more crushing energy than easier rocks with a higher crushability value.

CRUSHABILITY CLASSIFICATION

	Bond work index [kWh/t]	Crushability [%]	Los Angeles value	Ai-8mm product	Shatter index
Very easy	0 - 7	50 -	27 -	60 -	40 -
Easy	7 - 10	40 - 50	22- 27	45 - 60	35 - 40
Medium	10 - 14	30 - 40	17 - 22	30 - 45	30 - 35
Difficult	14 - 18	20 - 30	12 - 17	15 - 30	25 - 30
Very difficult	18 -	- 20	- 12	- 15	- 25

ABRASIVENESS CLASSIFICATION

	French abrasiveness [g/ton]	Abrasion index
Non abrasive	0 - 100	-0.1
Slightly abrasive	100 - 600	0.1 - 0.4
Medium abrasive	600 - 1200	0.4 - 0.6
Abrasive	1200 - 1700	0.6 - 0.8
Very abrasive	1700 -	0.8 -







Austenitic manganese steel

Austenitic manganese steel is a very tough and ductile material having a high impact toughness. Mn-steel is rather soft material having an initial hardness of approx. 220-250 HV. The wear resistance of manganese steel is based on a work hardening phenomenon.

When the surface of Mn-steel is under heavy impact or a compressive load, it hardens from the surface while the base material remains tough. The depth and hardness of work hardened surface vary depending on application and Mn-steel grade.



The work hardened layer can be between 10 and 15 mm deep and hardness can be up to 600 HV in primary applications. In fine crushing applications the work hardened layer is thinner and hardness is usually around 350-500 HV.

The Mn/C ratio and amount of Cr is not only relevant when it comes to the wear resistance of Mn-steel. The entire casting process

needs to be well optimized to produce high quality wear parts. Below are a few critical steps to producing high quality Mn-steel castings.

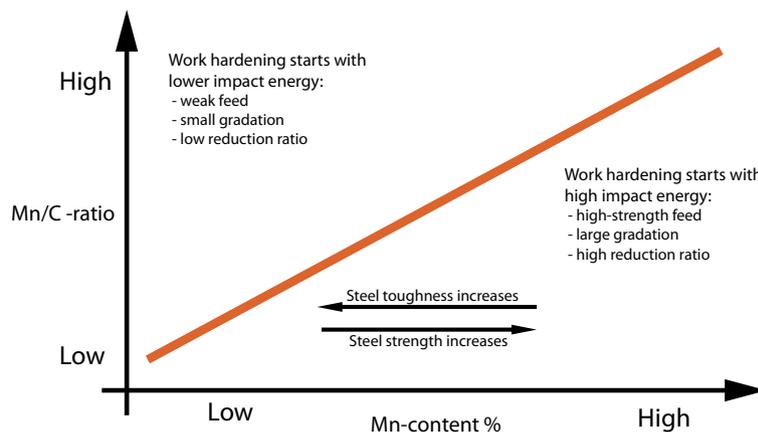
It all begins with raw material selection where raw materials are carefully selected for melting in order to get the material analysis inside strict specifications and to reduce the amount of certain impurities. During melting and pouring the temperatures are carefully controlled in order to achieve fine grain structure for the castings. At the same time samples are taken to verify the material analysis and adjust if necessary. Melted metal is then poured into sand molds where the metal slowly solidifies. The molds have carefully designed feeding and gating chan-

nels to ensure solid castings.

Heat treatment is another critical step to producing ductile high quality castings. Temperature, time and quenching need to be well controlled in order to avoid grain boundary carbide formation. After the heat treatment has been completed, castings are machined according to strict tolerance to ensure a perfect fit to the crusher.

Besides the casting, the cavity shape has a significant effect on the performance of the crusher and lifetime of wear parts. Cavity shapes are optimized by using sophisticated simulation tools and continuous testing and follow-up.

Utilization areas of different Mn-grades





Metso XT series

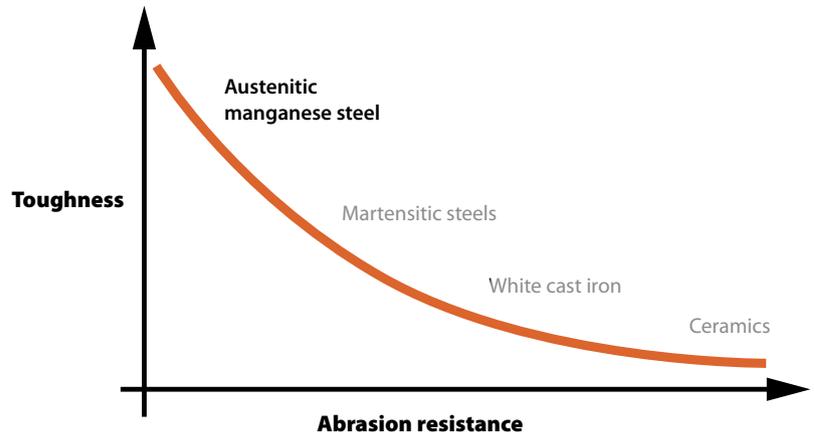
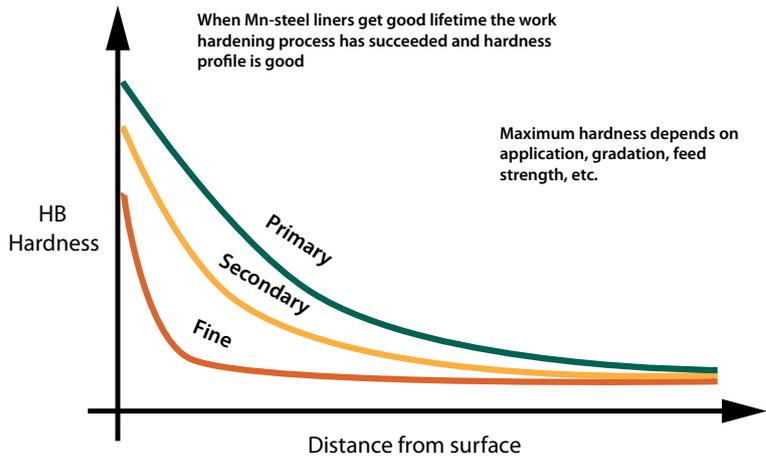
The Metso XT series has a wide range of Mn-steels with different alloying to suit each customer's application and the relevant rock properties. The XT series covers Mn grades from 11% to 24% and some grades are alloyed with Cr and other alloying elements.

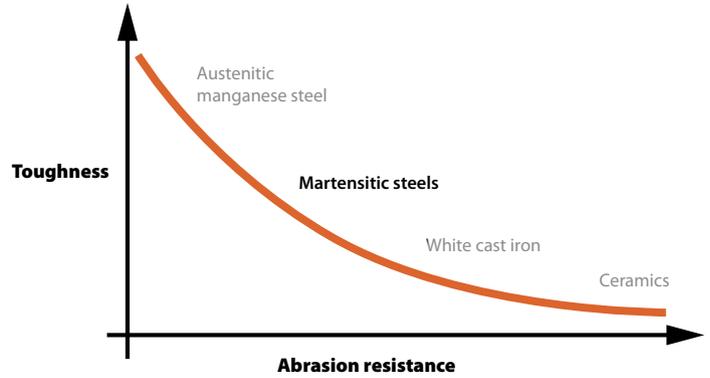
All materials are not available for each crusher.

Mn grade	Alloying
XT510	Low grade Hadfield manganese steel
XT520	Low grade manganese steel with molybdenum alloying
XT610	Low grade manganese steel with chromium alloying
XT710	High grade manganese steel with chromium alloying
XT720	High grade manganese steel with chromium alloying
XT750	High grade special manganese steel
XT770	High grade special manganese steel with molybdenum alloying
XT810	High grade manganese steel with chromium alloying and special treatment

Work Hardening vs. Final Hardness

When Mn-steel liners get good lifetime the work hardening process has succeeded and hardness profile is good





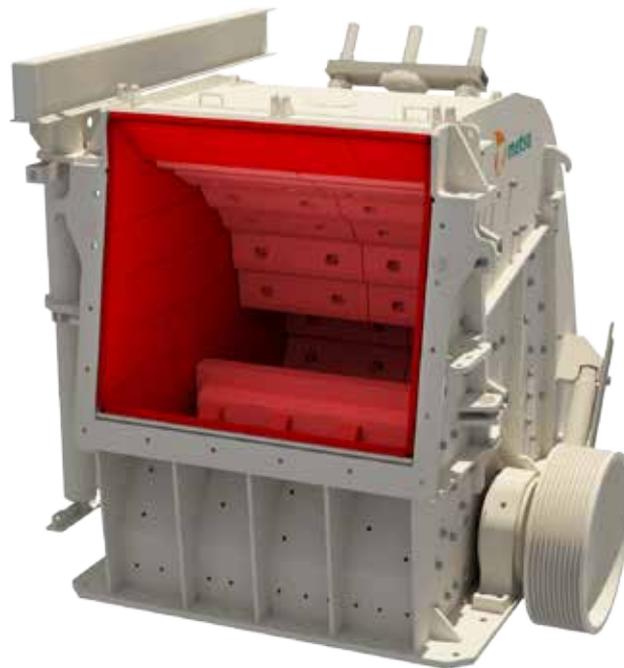
QT steels (Martensitic and AR steels)

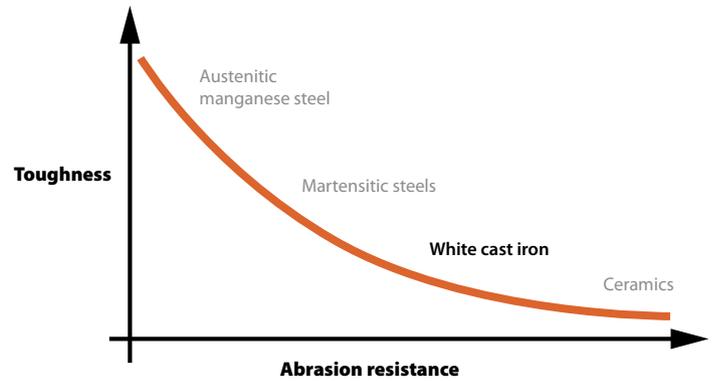
This material group offers quenched and tempered (QT) in good toughness for various crushing applications of impact and compressing crushing.

These steels has been tailored for various solutions having optimum microstructure with sufficient hardness and toughness achieved by heat treatment process called quenching and tempering. Precise control of time and temperature are the key parameters. Some grades are thermomechanically rolled. (AR steels or so called boron steels).

Concerning wear these steel give the sufficient hardness and toughness combination with economical way.

Consult your Metso representative for applications. Typical applications are in HSI and primary gyratory wear parts.





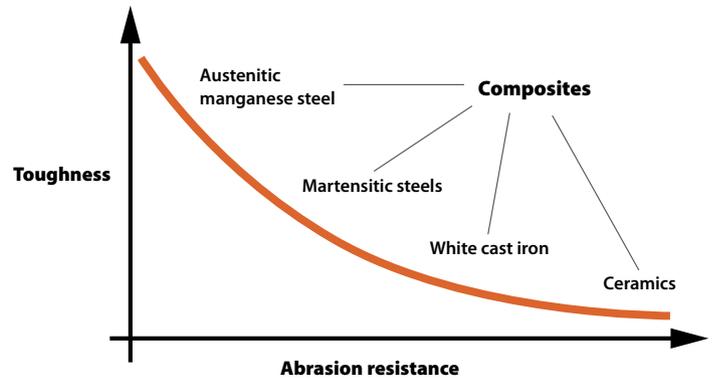
High chromium irons

This material group is offering classical solutions as well as more specialised solutions.

These materials are of low cost, and good choice for many applications. The wear resistance is based on the hard carbides on the relative hard matrix, still the composition and structure can be tailored considerably. Generally high chromium irons are commonly used in abrasive wear applications.

Consult your Metso representative for applications. Typical examples are VSI and HSI components and primary gyratory concaves.





Composites

Metal matrix composites (MMC)

MMC material group is the newest in Metso offering. Metal matrix composites are combining tough metallic matrix and hard ceramic or hard metallic materials together.

Wear resistance of material is combined with both optimum material strength (hardness) and toughness properties. The increasing strength (in metallic materials with sufficient toughness) has generally been observed to increase wear resistance in many wear environments. However, increasing strength generally results in loss of toughness.

In order to achieve the higher strength and toughness of metallic material, composite structure is the most promising solution.

Consult your Metso representative for applications. Examples of product are for example Xwin® product range in HSI crushers.

Xwin® is a registered trademark of Magotteaux.

Hybrid materials

Hybrid materials are constantly increasing in Metso offering. Hybrid materials are combining several kinds of materials together and can be called also as multimaterials.

These kind of structures have clear benefit in extreme operations, they can be tailored

for specific operation and form a functional wear control areas. The most wear resistant materials are located where they are needed, and with multimaterial joints even tailored surface (topography) can be formed in wear surfaces.

Hybrid can be combination of several types of irons, steels and ceramics or even rubber with the ceramics or metals.

Consult your Metso representative for applications. Typical example of product: Super jaws.

Weld overlays

Weld overlays combine high wear resistance on the surface and tough basematerial. Some of the overlays are well repairable on the field operations.



The most classical overlay has the properties of the high chromium iron, but there is also more sophisticated overlays available as well. The clear advantage of the overlays is

that they can easily be welded on the places where highest wear resistance is needed and the usage of the expensive material is minimized.

Consult your Metso representative for applications and overlay selection. Typical products are shields, quards and liners.



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