Current
Specialised Knowledge

Würth Abrasives

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The carbon content of steel has an influence on blasting abrasive quality.

Blasting with steel

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Blasting with steel blasting abrasives is a common procedure in surface engineering with a broad application area; it is used, amongst others, in foundries for fettling or descaling and rust removal. Steel blasting abrasives are also used to increase the hardness of surfaces by "shot peening" whereby the kinetic energy of the steel grains compresses the surface of the item being blasted and thus increases its hardness.

Quality criteria for blasting abrasives

Decisive quality criteria for blasting abrasives are their use (which is determined by endurance testing) and the intensity, i.e. the blasting effect on the part surface. Multidirectional blasting abrasives are more economical, the more they are blasted before they are broking up and filtered from the blasting abrasives cycle via the extraction system or filtering system.

Endurance. The durability of different steel blasting abrasives can be explicitly shown using endurance measurements in an Ervin tester by direct comparison. The Ervin tester is a test machine that simulates what is done in practice equipped with a spinner gate for use in a laboratory. The endurances of steel blasting abrasives are between about 2500 and 5000 cycles. The measurement result is highly dependent on the grain category being tested and the selected separation grain size. By separation grain size we mean the width of the sieve with which the undersized grain (too finely broken grain) is separated from the test quantity. Standardisation allows some leeway in the choice of separation grain size, which makes it difficult for the user to compare different suppliers because the quality information is determined on a different basis. In addition, suppliers refer to different norms and grain categories.

Intensity, Almen-test. The blasting intensity, i.e. the effect made on the part surface blasted by the blasting abrasive grains, is determined in accordance with the Almen test - a measuring procedure named after its inventor. The procedure is based on using a standardised measuring tape made of steel sheet.

Both the dimensions and the material composition are precisely established. This Almen test sheet is clamped in a clamping system that is likewise standardised and then blasted in an Ervin test machine using the spinner gate procedure. After blasting, the Almen test sheet is removed. The deflection of the tape measure (in mm) caused by the treatment is used as a standard for the blasting intensity used.

Thus, new grain tests and also compounds used in operating can be tested. As the intensity of the blasting abrasive is often changed with an increasing number of blasting cycles, the Almen intensity is given in relation to the number of blasting abrasive cycles made in the test machine.

Comparing different types of blasting abrasive

Endurance and also intensity are significantly influenced by the hardness of the steel whereby hardness results in turn from the chemical composition (significant C content) and possible heat treatments that have been made. High carbon (HK) and low carbon (LK) and, to a lesser extent, medium carbon (MK) steel blasting abrasives can be found on the market, which demonstrate the different manufacturing procedures and also have different advantages and disadvantages. The carbon content of high carbon blasting abrasives is at most >0.8 % 1) and the content of low carbon ones is 0.1 to 0.2 %. Other iron determiners such as silicon or manganese, have less of an effect on the hardness of steel. These high carbon blasting abrasives are given a certain hardness by a heat treatment that is comparable to low carbon abrasives. Due to the different chemical composition of them, there are, however, qualitative differences in endurance and intensity. The comparison in **Figure 1** clearly shows the different fracture behaviour of low and high carbon blasting abrasives. Due to the very high cooling speed during manufacture, high carbon blasting abrasives have an inhomogeneous mixture made of martensite and residual austenite. These structures have a different circumference and shrinkage behaviour whereby small cracks appear that cannot be completely removed by subsequent heat treatment. Due to this high crack forming tendency, high carbon blasting abrasives do not tend to achieve the endurances of their low carbon rivals.

Independent of the blasting abrasive other parameters are responsible for optimal blasting performance. This is mainly the type of blasting machine, and the setting of it and the special requirements of the parts to be blasted. A basic condition for optimising is that the blasting machine and the dust removal system is regularly maintained. In practice this is often not done, and so a positive blasting result can rarely be seen. It is also well-known that high carbon blasting abrasives wear the blasting machine slightly more than their low carbon rivals.

Thus, under comparable framework conditions, it is possible to reach the optimal result by choosing the right steel blasting abrasive. In **Figures 2** and **3** a comparison regarding the endurance and intensity of steel blasting abrasive samples is given as an example.

The values were determined under comparable conditions using new grain samples from corn classes 1.0 to 1.6mm typically used in foundries.

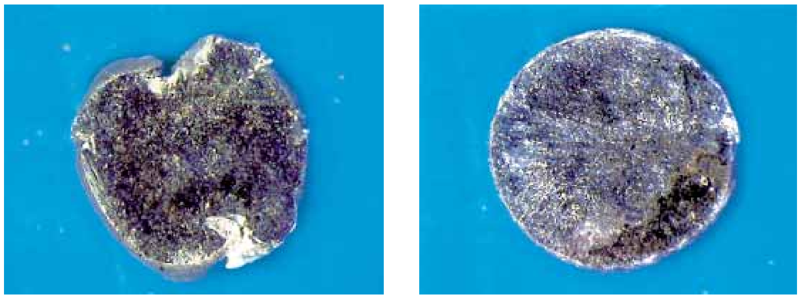

Figure 1 : a) high carbon and b) low carbon ground steel blasting grain

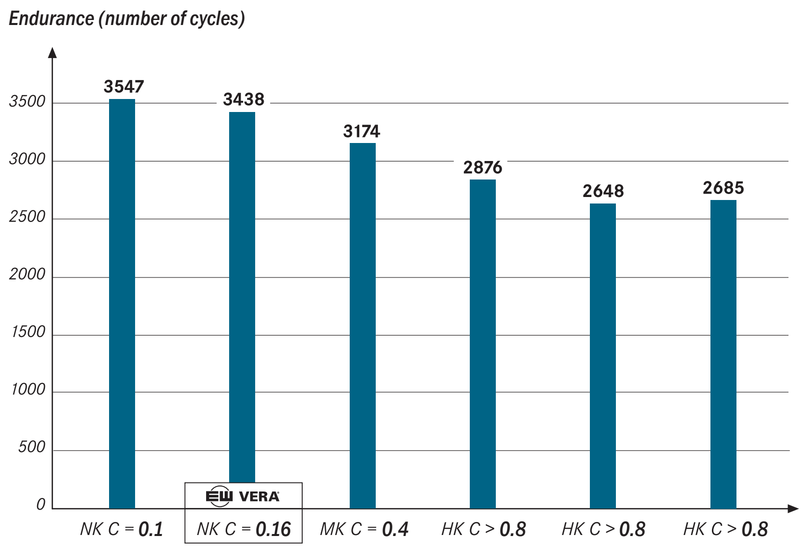

Figure 2 : endurance comparison of blasting abrasives from different suppliers; NK: low carbon, HK: high carbon, MK: medium carbon; C: carbon content in % (grain category 1.0 to 1.6 mm or grain category with comparable medium grain size; separation grain size 0.3mm)

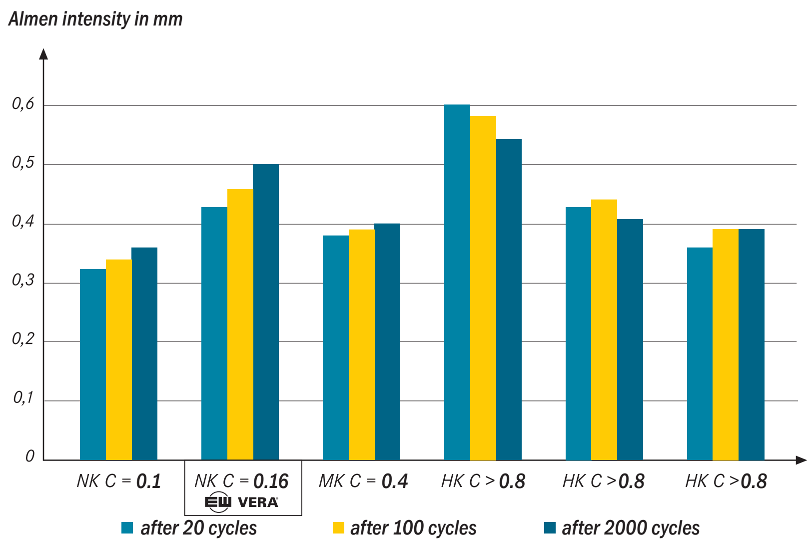

Figure 3 : Almen intensity of blasting abrasives from different suppliers

The endurance comparison in Figure 2 shows that the blasting abrasive use increases with an increased carbon content. With this grain size low carbon blasting abrasives have an endurance of about 3500 cycles. High carbon blasting abrasives have values of lower than 2900 cycles. Therefore, low carbon blasting abrasives have an endurance advantage of >20 %, which plays an important role in cost saving considerations. The intensity progression in Figure 3 shows the characteristic progressions of high and low carbon blasting abrasives. The low carbon ones are hardened within the first 500 cycles and thus increase intensity. The Almen value of the high carbon blasting abrasives on the contrary decreases within the first 500 cycles.

Evaluating the measurement results

Endurance and the intensity behave contrary to one another. With a low carbon content in the steel the endurance is improved but the intensity decreases. With an increased carbon content good intensities can be reached, but the endurance however is considerably decreased. Therefore, the optimum is to be found in a suitable compromise between long endurance and high intensity.

Figure 4 shows the blasting performance in connection with endurance and Almen intensity (calculated with the Almen intensity after 2000 cycles). The low carbon steel blasting abrasive with a carbon content of about 0.16% offers clearly the best performance mix. The low carbon blasting abrasive with 0.1% carbon was optimised for long endurance clearly decreased by the low intensity in comparison. The high carbon blasting abrasives partly achieve very good Almen values. For the endurance however, there were deficits. The medium carbon blasting abrasive is considered as a compromise between high and low carbon blasting abrasives but cannot however unite the positive characteristics of them.

The comparison showed that long endurance with simultaneously good intensity values are best reached with carbon contents (C) of about 0.16%. A resulting hardness of about 420 to 480 HV1 in the new grain is given. The advantage of this blasting abrasive is in the hardening of the individual grains in the mixture used in operating, as a result of which Almen intensities like those for high carbon blasting abrasives can be obtained. Due to the gentle production process of the low carbon blasting abrasive with about 0.16% carbon a regular bainitic structure is given even in spite of the hardening during the steel process in practice this means that optimisation measures can be carried out as shown in the following example:

If for a blasting use an Almen intensity of about 0.36 mm (Table1, column 1) as for a low carbon blasting agent with C = 0.1% with the grain category 1.0 to 16 mm is enough, then this can be replaced by a low carbon blasting abrasive with C = 0.16% with a fine granularity of 0.80 to 1.25 mm (column 3) thus, the same intensity is reached. With a decreasing grain category the endurance of the blasting agent in turn increases by about 500 cycles, which results in, at the same blasting intensity, an increase of more than 10% in endurance. Generally, the old principle can be used: the granularity to be selected is as rough as needed but as fine as possible.

By using a finer grain category, the level of cover of the blasted item is improved because the slightly finer granularity brings about almost a doubling of the number of grains blasted per kg of blasting abrasive. For many operations there is potential for improving the blasting result and the efficiency and there is a possibility of achieving a significant improvement in the process at a relatively low cost.

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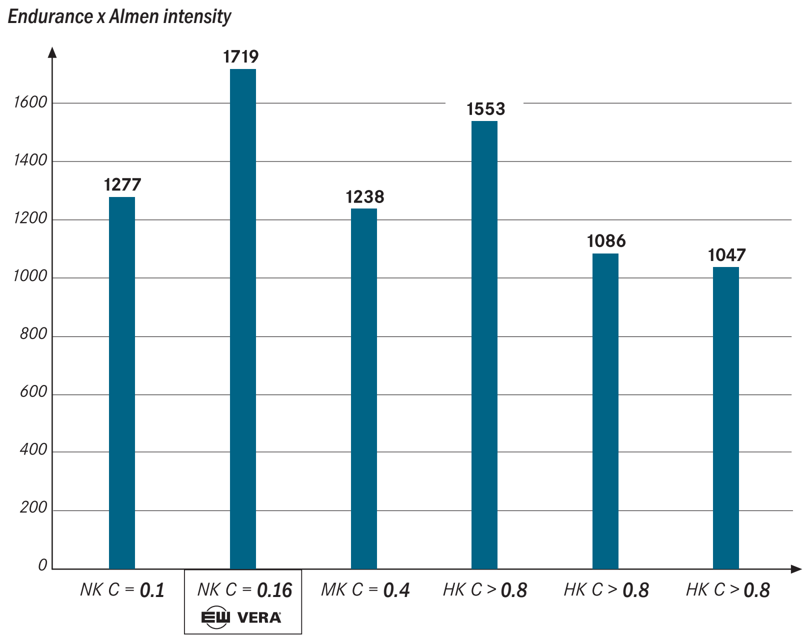


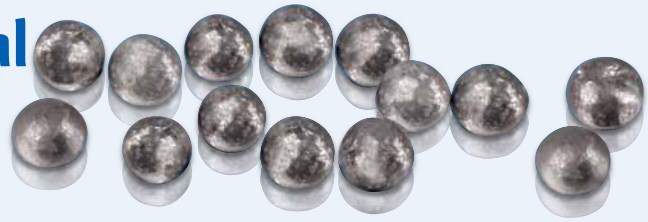
Figure 4 : Comparison of blasting agents from different suppliers (Endurance x Almen intensity)

Table 1 : Optimising the steel blasting abrasive by choosing a finer grain category(Endurance x Almen intensity)

	NK C = 0.1 Granularity 1.0 to 1.6 mm	VERA NK C = 0.16 Granularity 1.0 to 1.6 mm	VERA NK C = 0.16 Granularity 0.8 to 1.25 mm
Endurance (number of cycles)	3547	3438	3998
Almen-Intensity after 2000 cycles (in mm)	0.36	0.5	0.36
Endurance x Almen-Intensity	1277	1719	1439

Our cast steel blasting abrasive recommendation:

Steel shot abrasives
VERA® spherical
Code: GS-R



Analysis
C: 0.14 – 0.18 %, Si: 0.65 – 0.85 %,
Mn: 0.35 – 0.55 %, S: < 0.015%, P: < 0.015%

Structure
bainitic/martensitic

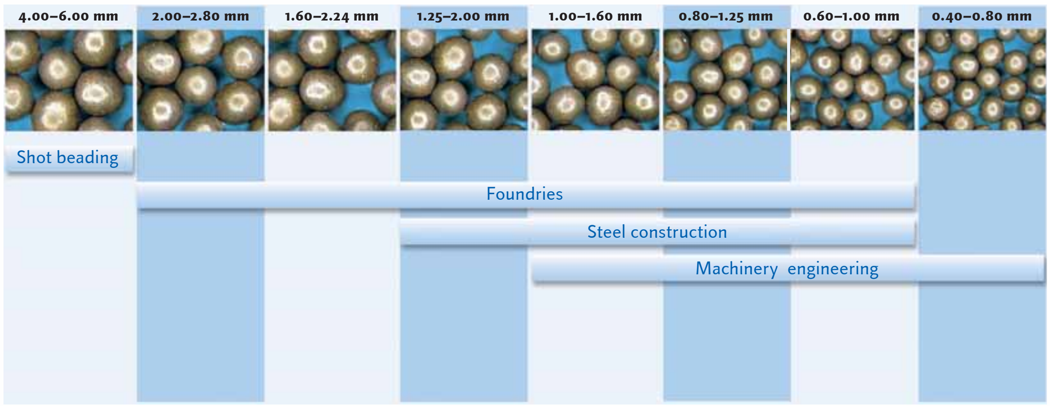
Hardness
as new grain:
HV 1.0 approx. 420 – 480 ≙ HRC 42.7–47.7
as operating mixture:
HV 1.0 approx. 460 – 520 ≙ HRC 46.1–50.5

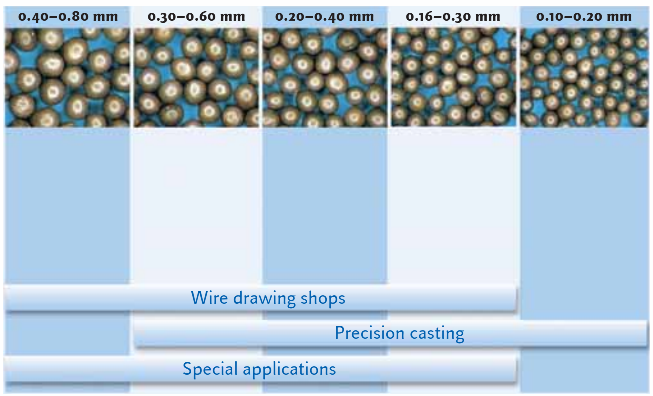
Specific gravity
approx. 7.40 kg/l

Bulk density
approx. 4.40 kg/l

Screening specification
DIN 8201 part 2 or according to customer

Available grain sizes and their uses





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