Cods and edge disintegration

Characteristic features
Cracking and breaking of sand cods, iron fins penetrating into cracks. In the case of breaking of complete parts of the mould, inclusion of the cod in the casting.

Incidence of the defect
Breaking of cods occurs with too brittle or with highly compacted sands. The defect is particularly evident with deep cods or where their depth/width ratio is unfavourable. The pattern design has a considerable effect on this defect.

Explanations
Cod breakage occurs when its adhesion to the pattern is greater than its tensile strength. It most frequently arises when the mould is being stripped from the pattern and where the moulding sand has insufficient plasticity.

Possible causes

Moulding plant
- Uneven stripping of the mould, excessive leverage on the cod
- Tapers on pattern and mould are too small
- Formation of sand bridges through uneven filling of the sand
- Compaction too high, thus too much mould/pattern adhesion

Clay-bonded sand
- Insufficient plasticity
- High dust content in the sand
- Sand too hot
- Insufficient bentonite-binding capability
- Too much clustering

Remedies

Moulding plant
- Improve stripping from pattern; the mould is often not evenly stripped
- Distribute sand evenly in the flask
- Avoid excessive local compaction and thus too much mould/pattern adhesion
- Increase taper on pattern and mould
- Reduce compacting pressure in the moulding plant
- Use a release agent

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Fig. 3: Grey iron casting after a cod has broken off in the mould and remained in the pattern.
Scale: 10 mm = 30 mm

Fig. 4: Grey iron casting. Broken off sand edges adhered to the pattern.
Scale: 10 mm = 8.1 mm
Background information

Cods and edge disintegration

Plasticity of circulating sands is very much dependent on the degree of mulling, and increases with an increase in the pre-moisturizing of used sand. Fig. 5 shows this by the example of bentonite-bonded circulating sands. Even when mixed five times longer with the same amount of water, a thoroughly dried-out sand will not achieve the same plasticity as a moist circulating sand. The sand only reaches a comparable plasticity when it has been stored for a period of 3 hours after pre-moisturizing with 1.5 % water. In our opinion, the used-sand moisture content should be between 2 and 3 %. The reduced flowability of these sands must be taken into account in the design of storage and conveying systems.

Fig. 5

When circulating sands have insufficient plasticity, their green tensile strength should be measured after sufficient storage time. In the event of too high a proportion of fine inert dust, the sand becomes brittle. In practice, it has been shown that moulding sand becomes considerably more brittle when the inert fine dust content exceeds 3 %.

Dust extraction and possibly bentonite quality must be matched to the requirement for low proportions of inert dust. The use of bentonite with a high montmorillonite content can frequently boost the green tensile strength to such an extent that cuds no longer break off and there is no edge crumbling.

Boenisch introduces the concept of a ductility limit as a measure for plasticity and shows that raising the montmorillonite content in the bentonite considerably increases plasticity, thereby reducing the risk of cod breakage. In the same paper he points out that a high admission of used core sand or new sand drastically reduces plasticity without reducing green compression strength. We have already pointed out the need for sufficient development of bentonite. The temperature of the moulding sand also has a great influence. With temperatures in excess of 40°C, sand embrittlement is likely to be a constant problem. A 10 to 20 % reduction in green tensile strength already occurs at sand temperatures of 40°C. Hot sands quickly lose their surface moisture, resulting in embrittlement. These phenomena have been studied by Pohl.

Clay-bonded sand

- Improve plasticity of the sand. This can be done by increasing the bentonite content whilst retaining the same compactability, or by raising the compactability.
- Improve development of the moulding sand. It is important to pre-moisturize used sand at an early stage (min. 2 % water with approx. 8 % bentonite in the sand).
- Use carbon carriers containing process carbon, e.g. Antrapur and Priocarbon. Use of bentonites containing process carbon, e.g. Quickbond, very much accelerates development.
- Improve flowability of the sand during compaction. This can also be achieved by using products containing process carbon.
- Reduce proportion of inert dust. The moulding sands will otherwise lose their plasticity. Use bentonite with a high montmorillonite content and restrict recirculation of dust.
- Reduce the proportion of clusters. If necessary, use a sand disintegrator; otherwise, limit the total amount of fines (bentonite + inert content).
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