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.

Incidences 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

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

Cod breakage is most frequently caused by defects in the moulding plant. When it occurs, the first thing to check is the separation between mould and pattern plate. The mould must be stripped without tilting. Especially with deep cods, even 0.2 mm will cause an over-critical tilt, thus leading to the cod breaking off. When assembling the cope and drag halves, it is important that the locating pins are not worn and that the mould halves can be fitted together without displacement.

When cods do break off, their taper should be checked and, if necessary, altered.

It is essential to uniformly fill the mould areas and cods with moulding sand. The sand must be aerated and introduced with as few clusters as possible, otherwise sand bridges can form across recesses in the pattern, thus making it difficult to fully fill the mould. The correct matching of sand quality to moulding plant with regard to flowability and plasticity has a great influence on the occurrence of defects. With excessive compaction, the mould/pattern adhesion of the cod increases to a greater extent than the cod tensile strength. Increasing the flowability of the sand contributes to maintaining low compacting pressures.

The use of products containing process carbon assists in improving flowability.

Release agents considerably affect the stripping characteristics of the cod. In his work, Levelink describes the influences that the pattern material and also the sand and pattern temperatures have on the adhesion forces. The properties of clay-bonded moulding sand also have a great influence on the breakage of cods and edges. The sand plasticity should be kept as high as possible.

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.

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 cods no longer break off and there is no edge crumbling.

Baenisch 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.
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