Possible causes

Moulding plant
- Break-up of mould sections during stripping of patterns, core setting or assembling of moulding flasks
- Uneven compaction of moulds, compaction too high in places.

Clay-bonded sand
- Low compactability
- Bentonite content too low, or poorly developed bentonite
- Inert material content too high
- Lump content too high
- High content of lustrous carbon producer

Resin-bonded sand
- Low core strength
- Excessive core mismatching

Gating and pouring practice
- Pouring rate too high, with heavy impact against mould wall surface resulting in erosion
- Ladle too far above pouring basin
- Pouring time too long

Characteristic features

Irregularly formed sand inclusions, close to the casting surface, combined with metallic protuberances at other points.

Incidence of the defect

Sand inclusion is one of the most frequent causes of casting rejection. It is often difficult to diagnose, as these defects generally occur at widely varying positions and are therefore very difficult to attribute to a local cause. Areas of sand are often torn away by the metal stream and then float to the surface of the casting because they cannot be wetted by the molten metal. Sand inclusions frequently appear in association with CO blowholes and slag particles. Sand inclusions can also be trapped under the casting surface in combination with metal oxides and slags, and only become visible during machining. If a loose section of sand is washed away from one part of the mould, metallic protuberances will occur here and have to be removed.

Explanations

With bentonite-bonded moulds, sand inclusions can be caused by cold and edge disintegration, sand crust formation or erosion.

The latter results in the inclusion of individual sand grains. Sand crust inclusions and individual sand grains can also be detached from resin-bonded moulds, and are then included in the casting.

Sand inclusions

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Sand control → P. 182

Description of defects: Sand inclusions

Fig. 42: Inclusions of large areas of sand and individual sand grains in a grey iron casting.
Scale: 10 mm = 8 mm

Fig. 43: Micrgraph of an inclusion defect in a grey iron casting. The embedded sand grains are clearly recognizable.
Scale: 10 mm = 0.08 mm
**Remedies**

**Moulding plant**
- Check moulds for pressure marks and, if necessary, insert pressure pads.
- Carefully blow out mould cavities.
- Improve pattern plates, increase pattern tapers and radii. Heat pattern plates and, if necessary, use release agent.
- Check the moulding plant for uniform flask stripping and overhaul moulding plant as necessary.
- Automate core-setting. Check and, if necessary, modify core prints before start of production.
- Ensure uniform mould compaction, avoid over-compacted sections.

**Clay-bonded sand**
- Raise compactability and thus plasticity of the sand.
- Increase bentonite content. Use bentonite with high specific binding capacity. Improve bentonite development by extending mixing time or by pre-wetting used sand.
- Reduce inert dust content. Decreasing the dust content reduces lumps in the sand.
- Reduce content of lustrous carbon producer.

**Resin-bonded sand**
- Increase the strength of the cores. Use greater proportion of binder.
- Compact cores more evenly and effectively and, if necessary, inject gas more evenly.
- Avoid core mismatching.

**Gating and pouring practice**
- Avoid high pouring rates and impact of metal stream against mould walls.
- Shorten pouring times, improve distribution of gates.

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**Description of defects: Sand inclusions**

Metal flowing into the mould cavity can detach sections or individual sand grains from the mould during pouring, and transport them to remote parts of the casting. Portions of the gate are often carried away through erosion (see also casting defect “Erosion”). This leads to sand inclusions in the proximity of the gate of the casting. Measures required to counteract this are any of those which increase the resistance of the mould to erosion.

Edge disintegration results in whole sections of the mould being carried into the casting during pouring (see casting defect “Cods and edge disintegration”). Edge disintegration arises during moulding, during assembly of the moulds, during core-setting and, above all, when the sand has insufficient plasticity. Torn out areas of the mould cannot be visually detected and, during pouring, frequently cause disintegration of whole sections. All measures which increase the plasticity of the sand reduce susceptibility to this defect.

Scabbing (see casting defect “Scabbing”) can also lead to sand inclusions in the casting. All measures to reduce compressive stress and increase green tensile strength reduce the risk of sand inclusions through scabbing. To determine the causes of sand inclusions, it is recommended to shot-blast castings together with gates and feeders. By this means, it is often possible to attribute sand inclusions to defects in the mould. By opening a mould which has been closed, it is frequently possible to ascertain pressure marks which could lead to sand defects.

In the case of resin-bonded moulds, sections can disintegrate as a result of excessively low strengths, thus leading to inclusions. When such defects occur, core compaction, strength and storage stability under elevated humidity must be examined.