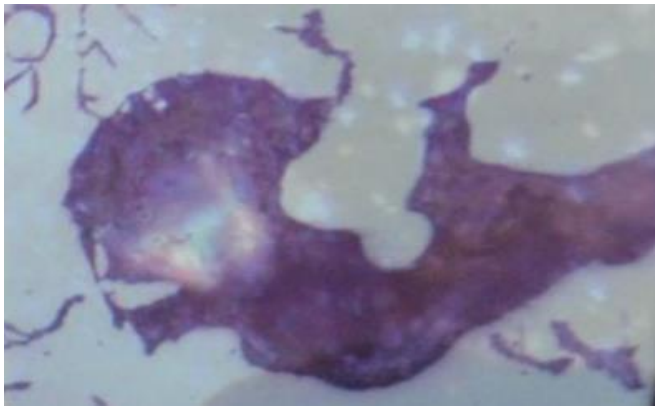
DEFECTS

Index

1. Sand Inclusion

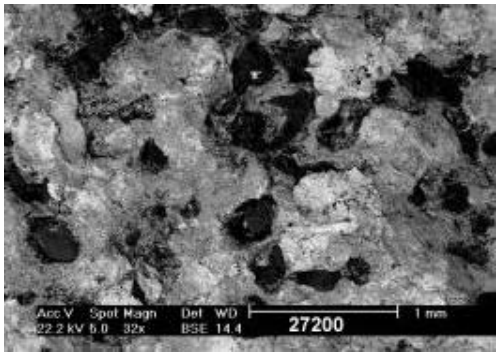


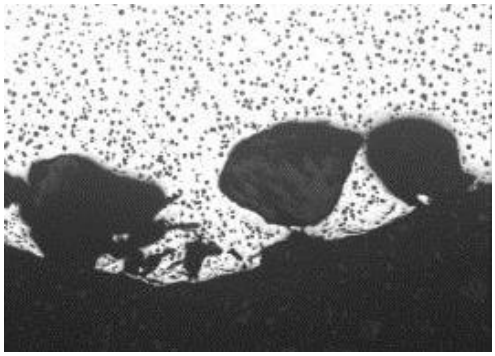
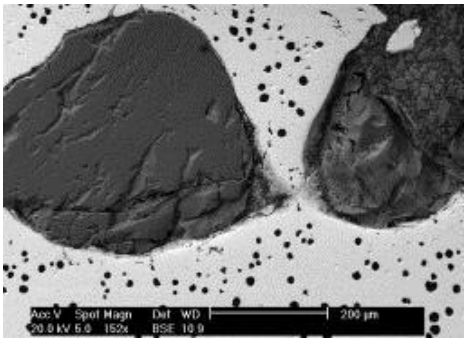

DEFINITION:

- They are silicon sand grain constellations with grey mate colour, originated at the mould, drag by the casting towards the upper part of the mould.
- They appear during the deburring o machining of the part at the first exterior millimetres of the bottom part.
- While machining they are quite abrasive towards the tool.

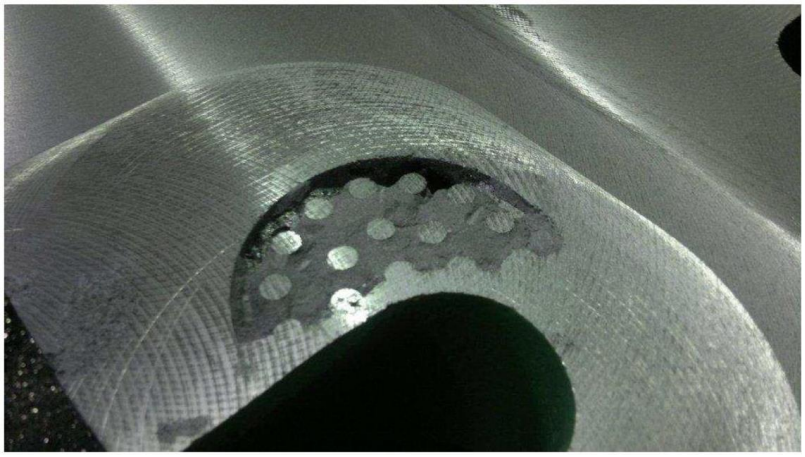
POSSIBLE CAUSES:

- Low mechanical properties of the mould.
- Turbulent casting and/or mould erosion due to an inadequate filling system.
- Calcinations, due to low sand compactability.
- Mould break.



2. Ceramic Inclusions

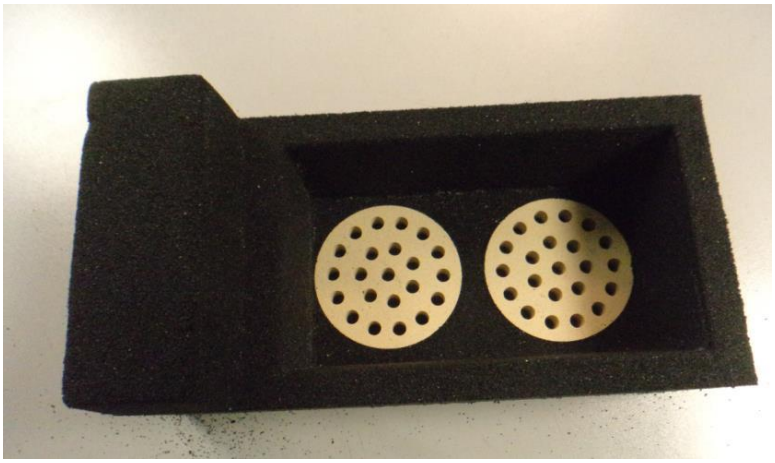


CHARACTERISTICS:

- They are ceramic traces, light grey mate coloured, coming from the filling system, broken and dragged by the melted iron towards the upper side of the mould (in casting position, lower part of the casting)
- They appear during the machining, together with sand and slags.
- While machining it produces tool abrasion.

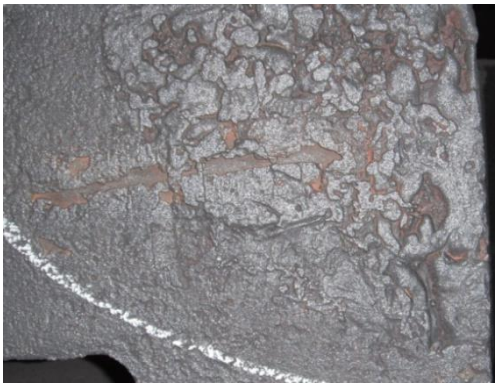
POSSIBLE CAUSES:

- Generally, because of the hit of the melted iron.
- Breaking of the sand holding the filter or regulator in position.
- Slag saturation of the filters or regulators.



3. Paint Inclusion



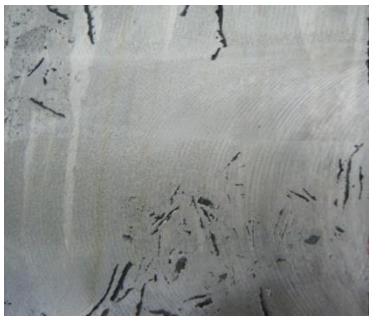


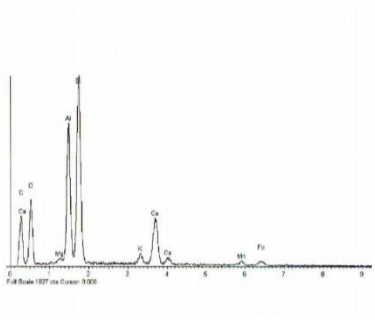
CHARACTERISTICS:

- These inclusions come from detachment of the refractory paint with which we paint the lost form patterns, dragged by the pouring mixture towards the upper part of the casting.
- There are discontinuities in a flat form that appear at the cavities of the upper parts of the piece (in casting position). The size depends on the detached amount paint.
- While machining them, paint inclusion is linear, sandy with dark colour y get attached to superficial parts of the casting. They usually appear together with sand inclusions.
- While machining can cause abrasion of the machining tool.

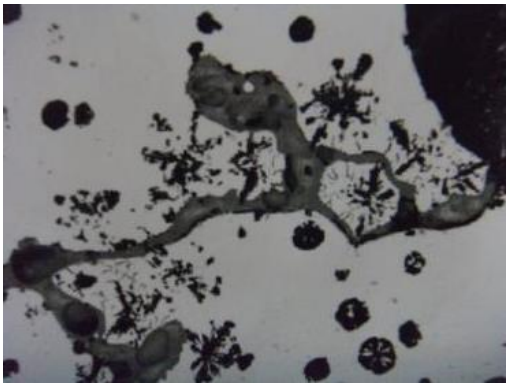
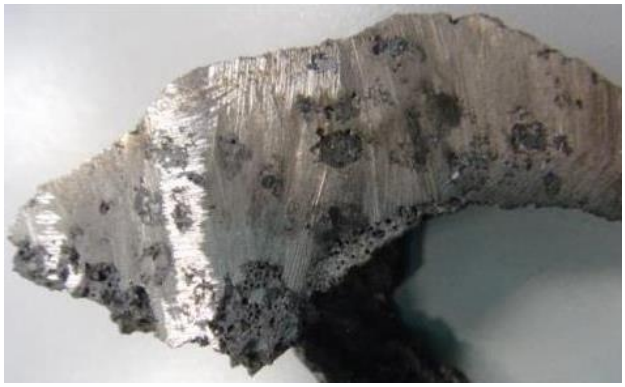
POSSIBLE CAUSES:

- Low mechanical properties of the mould.
- Penetration of the paint into the mould due to the separations at the mould unions.
- Calcinations, due to a low siliceous sand compactability.
- Pattern with wet paint and/or accumulations of paint not properly attached.
- Paint with low attachment properties.





4. Slag

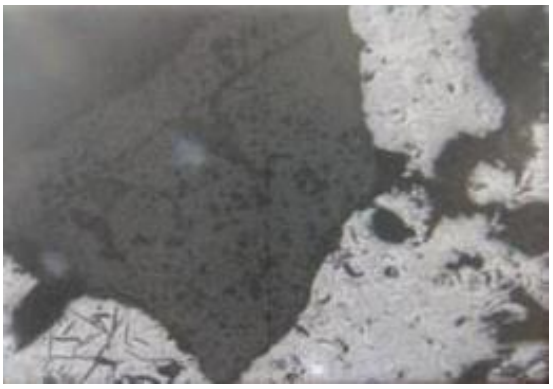



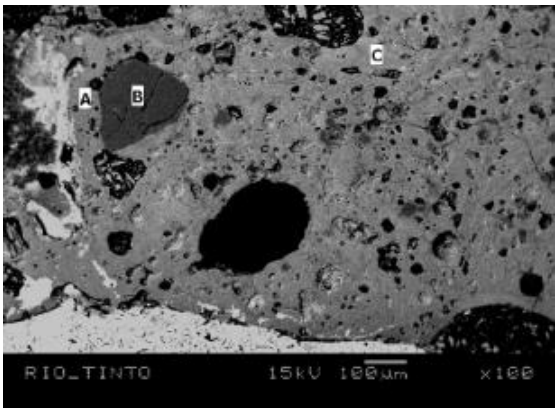
CHARACTERISTICS:

- They are irregular form non-metallic inclusions, on upper part of the casting (in a casting position, bottom part of the finished casting).
- They are light grey sand colour, and occasionally they can be confused with sand inclusion, they have however a more cavernous form. They are usually located on the part surface, close to the casting inlets.
- While machining produces tool abrasion.

POSSIBLE CAUSES:

- Slag excess from nodulization due to the high Sulphur content of the pig iron.
- High Sulphur and Manganese content.
- Excessive additions of materials that produce slag.
- Low melting temperature.
- Turbulent casting filling.
- High equivalent carbon (CEq).
- Insufficient de-slagging during the casting process; Filtering, filling design, de-slagging.
- Lack of traps of slag filters
- Dirty ladles.




A
B
C
RIO_TINTO
15kV
100µm
x100

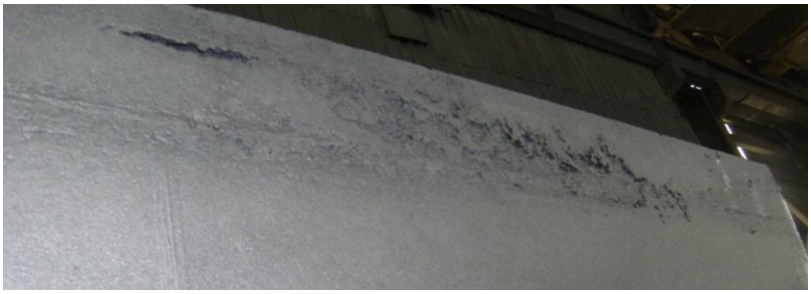
5. Primary Shrinkage


CHARACTERISTICS:

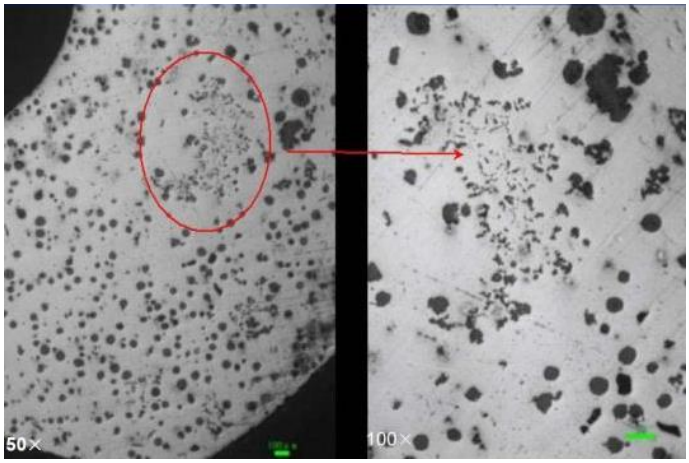
- It appears like open cavities or closed to the exterior, the surface is usually flat, and occurs in last solidifying areas.
- It can also be present like a depression or and sinking at the external surface of the mould, sometimes not being a cavity.

POSSIBLE CAUSES:

- The primary shrinkage is produced due to the liquid contraction occurring at the metal from melting to the final solidification.
- Lower the Equivalent Carbon (Ceq), higher the metal contraction and consequently higher shrinkage tendency.
- With a higher melting point, more time the metal is contracting and consequently more time for the shrinkage to from.
- Inadequate filling system and/or alimentation system.
- Hot spots resulting from wrongly designed entrances.
- Low mechanical properties of the mould, causing a mould dilatation.
- Lack of size and chiller position.
- High liquidus temperature, depending on the Ceq position.
- Insufficient, poor or low inoculation.
- High residual magnesium.

6. Chunky Graphite

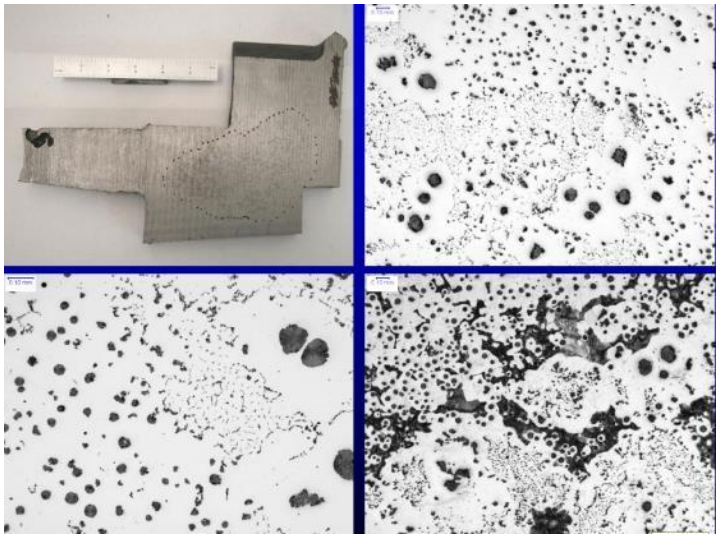


CHARACTERISTICS:

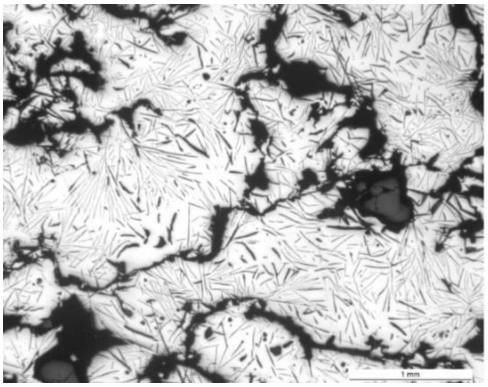
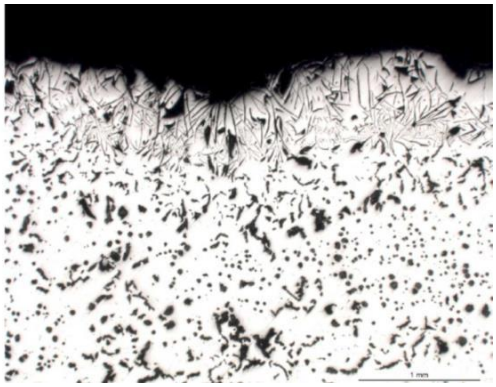
- It is a graphitic malformation present at ductile castings.
- Appears at thick sections of the casting and during slow solidification processes.
- Hipereuthectical compositions can appear.
- Graphitic flotation can appear.
- Chunky graphite deteriorates the material mechanical characteristics; resilience, lengthening, traction resistance, elastic limit, fatigue behaviour.
- Chunky lower than 20% does not generate severe deterioration at the mechanical properties of the material.

POSSIBLE CAUSES:

- Rare Earth excess at the metal.
- Metal produced with high quality raw material.
- Excessive inoculation.



7. Flake Graphite at the Ductile Iron Parts Surface

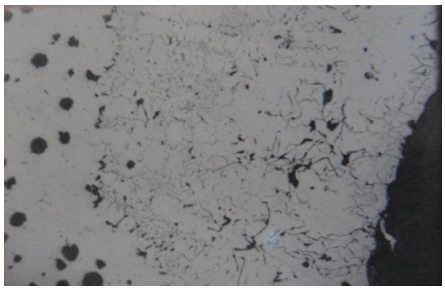



CHARACTERISTICS:

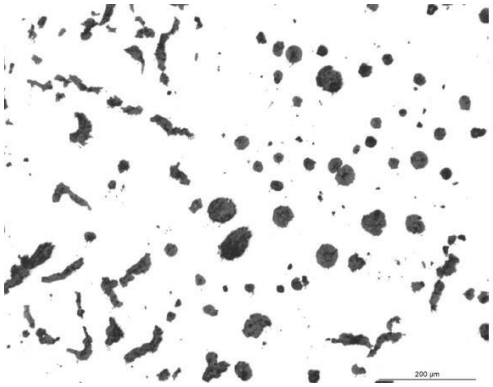
- It is a surface degeneration of the graphite present on ductile iron, appearing as layers or flakes
- These irregularities appear as a result of the chemical reaction between the metal Mg and the sand S.
- The layer thickness depends on the part module of the part, cooling speed, S amount on the sand and Mg quantity on the metal.
- The flake graphite layer reduces the mechanical properties of the part surface. (Hardness, Tensile Strength and Ductility)

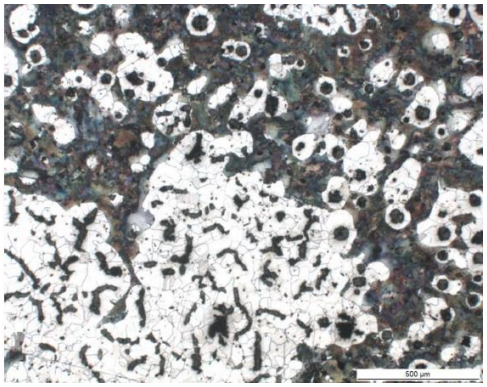
POSSIBLE CAUSES:

- Low residual Mg (<0.025%).
- High S contents at the sand mixture (>0.10%) due to the high contents on the catalyser
- Low regenerated sands, with moulding remains such as catalyser and resins, and/or low new sand contribution.
- In large section parts, it can be caused by the high content of the following elements; Ti, Bi, Sb, Te.
- Long feeding systems, low filling circuits, insufficient mixture of the metal and turbulent pouring (Mg losses due to oxidation).
- Occasionally this defect can appear together with Dross type inclusions and vermicular graphitic malformations.



8. Compact Graphite



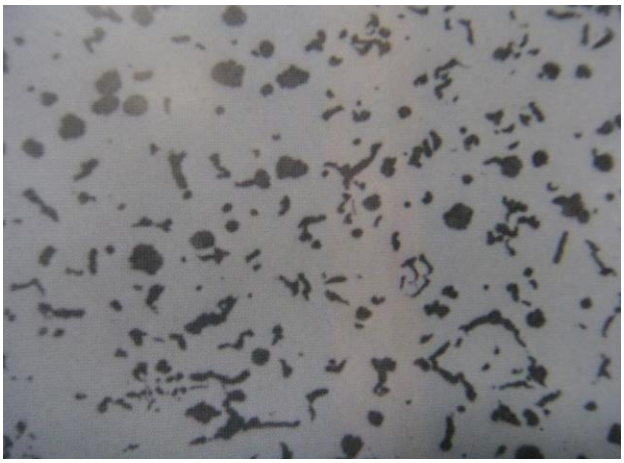


CHARACTERISTICS:

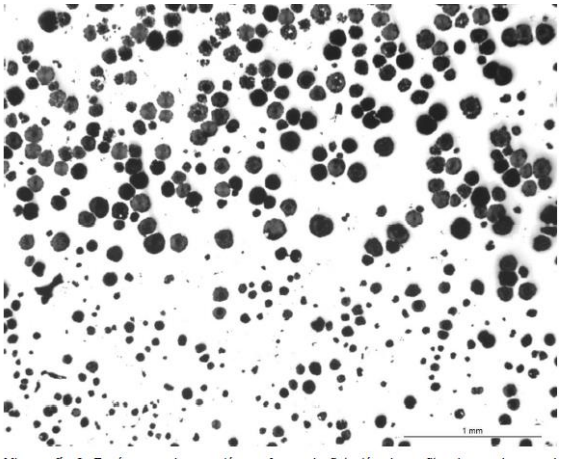
- Is is a graphitic degeneration. The graphite has worm-similar forms with round edges. Is a lack of spheroidization.
- It can appear together with well-formed spheroids and generally among the metallic matrix.
- The appearance of this defect reduces the mechanical characteristics of the material.

POSSIBLE CAUSES:

- Low active Magnesium content (<0.025 – 0.030%).
- Excessive delay between nodulization until casting.
- Ce or rare earths Low content.
- High nodulization temperature.
- High S content at the base iron and/or low desulphurization effect during the nodulization.



9. Graphite Flotation



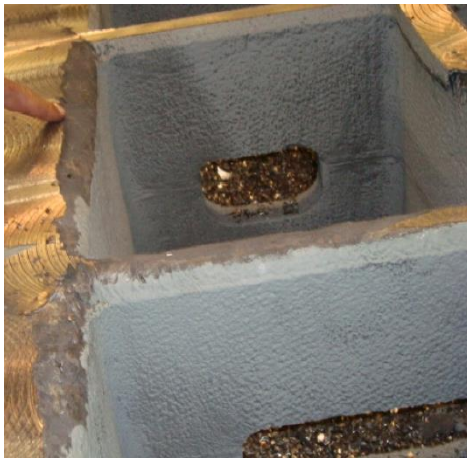
CHARACTERISTICS:

- Appears at ductile iron hipereutechtical castings.
- It is a massive concentration of large size graphite nodules.
- Considerably reduces the mechanical characteristics of the area.
- It appears at the upper zone of the part, in casting position.

POSSIBLE CAUSES:

- High Equivalent Carbon.
- Slow cooling down speed at thick sections of the part.
- Not enough inoculation (Composition and/or rare earth content)
- High pouring temperature.

10. Lustrous Carbon Inclusion



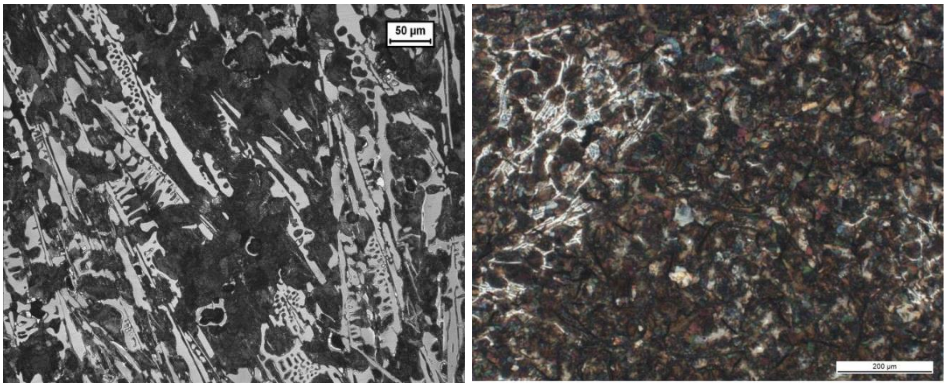
CHARACTERISTICS:

- Presence of filling marks, inclusions and / or metal separations due to a impermeable carbon film or flakes which gets attached onto the surfaces of the part.
- The defect´s surface shows a curved and shiny finish, appearing a bright carbon film deposited on the metal.
- In some cases, separation of metal and / or internal inclusions is formed because of turbulences or liquid metal heavy flows transporting lustrous carbon flakes.
- Usually, the defect is located on top of the parts (casting position) and in areas affected by high turbulence.
- In case of spheroidal casting, they appear together with oxidation and slag inclusions.
- Lustrous carbon inclusions are formed at temperatures above 650 ° C, causing a film left on the silica grains.

POSSIBLE CAUSES:

- The excess of materials capable to generate lustrous carbon (styrene, refractory painting) in the sand allows this material to be deposited even before the metal completely fills the mould cavities (green moulding).
- Filling systems which promote turbulence filling regimes.
- Excessive filling times.
- Low casting temperatures and / or use of very long casting channels (temperature losses in the metal).
- Low permeability in moulds and / or punches.
- Insufficient gas exits in moulds and/or punches.
- Metal turbulences change the position of the deposited carbon sheets, creating creases which may appear on the surface of the defect.

11. Carbides

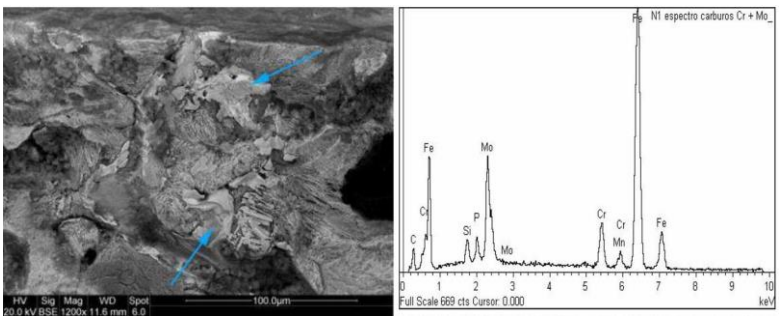


CHARACTERISTICS:

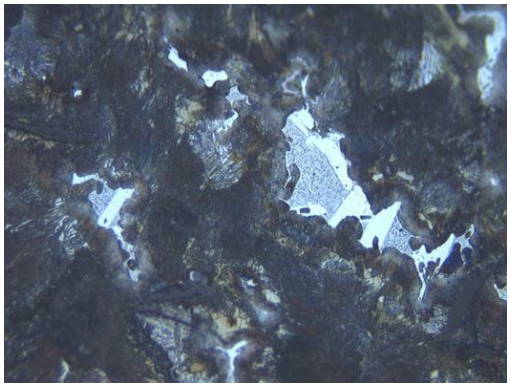
- The carbides are compounds of carbon and another component.
- The carbide content increases notably the hardness and lowers the tenacity (total energy absorbed by a material before reaching the breaking point).
- The carbides are points that increase the fragility of the casting.
- If carbides appear, the casting is more fragile and while machining it presents excessive hardness and consequently break of the machining tool.

POSSIBLE CAUSES:

- Excessive addition of Magnesium and Rare Earths.
- Composition content of carbide generating elements like; Mg, Cr, Mn, V, W, Ti, Mo, etc.
- Quick solidification, due to thick walls or surfaces in contact with chillers…
- Not enough inoculation.
- The used inoculant has neither the size nor the chemical composition required by the material quality.
- High maintenance temperature or long maintenance time for the casting.
- Low casting temperature. The iron becomes cold very fast.
- Low Equivalent Carbon (Ceq). Inadequate amount of C and Si for the casting thickness.
- For grey casted iron, decompensated relation between S and Mn.



12. Steadite

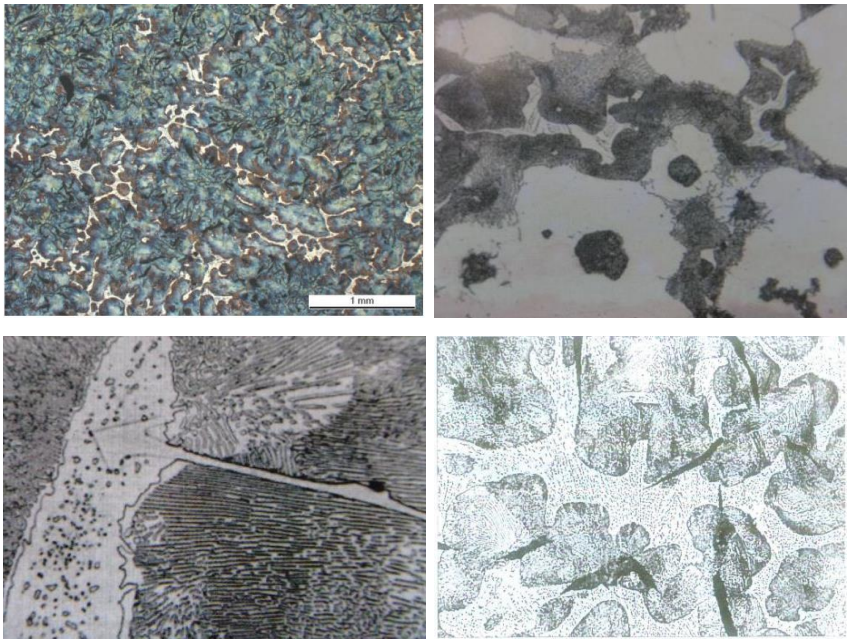


CHARACTERISTICS:

- Steadite is Iron Phosphide and appears at the grain borders.
- Steadite content increases notably the hardness and lowers the tenacity (total energy that a material can absorb before breaking).
- If steadite is present, the casting is fragile and while machining several problems can occur due to excessive hardness and in consequence tool breaks.
- Steadite can cause micro-shrinkages.

POSSIBLE CAUSES:

- Excessive and high Phosphor content usually appears when Ph is higher than 0.15%.
- It also increases shrinkage tendency and metal fragility.
- Slow cooling process in thick sections of the casting.



13. Calcination

CHARACTERISTICS:

- Calcinations are sand firmly added to the casting surface. The melted metal has penetrated the sand, recovering the grains and forming and adherent crust.
- Calcinations appear with more frequency at the metal entrances, hot spots, and massive areas.
- Normally, calcinations originate sand dragging and sand/paint inclusions.
- If not completely removed while deburring, they may produce abrasion to the machining tool.

POSSIBLE CAUSES:

- Lack of refraction of the paint, used to paint pattern or mould.
- Sand humidity.
- Low mould refraction, produced by: Poor furanic resin (Low furfurilic alcohol content), Low resin content on the mixture sand-resin, High water content at the sand-resin mixture, Too big sand grains, High sand temperature on mixture, Low sintering point at the sand…
- High melted iron temperature.
- Lack of mould compactability.

14. Mould Not Filled

CHARACTERISTICS:

- When the mould does not get completely filled, the result while demoulding is a lack of material on the upper side of the casting as in the casting position (bottom of the part). Generally, the surface with lack of material has rounded forms and cold unions.
- The part not completely filled are internally dismissed and replaced.

POSSIBLE CAUSES:

- The pattern polystyrene has a lower density that the stipulated 20kg/m3, originating while doing the charge prediction, that this is not enough.
- Wrong weight of the melting crane weighing.

15. Cracks, Traces and Discontinuities at Polystyrene Pattern Unions


CHARACTERISTICS:

- Linear discontinuities on the metal surface, the deep varies depending on the pattern separation and the refractory paint penetration.

POSSIBLE CAUSES:

- Gap between layer unions or pattern parts.
- Missing tape masking the union between layers.
- Gap between steel sleeves and lifting ear holes because insufficient glue and/or tape on junction.