

Discoloration in the Vacuum Furnace

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The paper talks about the different ways that contamination can occur during heat treatment. It covers improper washing, vacuum furnace leaks, hot zone contamination, cooling and partial pressure gas contamination, and incorrect process parameters in detail, including the sources, chemical reactions, and color coding for discoloration. Furthermore, the paper presents how vacuum furnace designs and gases used can impact discoloration during heat treatment. Lastly, the paper discusses preventing surface contamination in the vacuum furnace.

The contamination process is gradual, and the discoloration will deepen over time. The level of discoloration is influenced by process parameters such as vacuum and temperature.

Parts and hot zones in vacuum furnaces begin to get contaminated when they reach a temperature of 200°C to 260°C (400°F to 500°F) and again during the cooling phase. During the heating phase, most contamination is caused by remaining oxygen, minerals/salts used during machining (cooling fluid), and improper washing methods. These machining cooling fluids and washing contaminants will appear on parts after thermo-chemical processes such as low-pressure carburizing as soft spats and slight discoloration.

Properly cleaning parts and fixtures is a crucial step to avoid discoloration, spats, and soft hardness spats on parts. Organic (non-polar) parts and fixtures that are contaminated from processing or preserving parts before heat treatment, such as oils, fats, greases, paraffin, adhesives, resins, and petroleum compounds, can be removed using non-polar cleaning media, such as chlorinated, halogen-free hydrocarbons, and modified alcohols. On the other hand, polar (inorganic) contamination, such as salts, soaps, emulsions, coolants, polishing pastes, protective paints, traces of dirty hands, dust, scale, rust, grinding, abrasive, and blasting residues, as well as the chips themselves, can only be removed with aqueous solutions.