I. Purpose of a Carbonaceous Additive

A. Reduce imperfections due to the rapid reaction between the silica sand mold and the oxidized surface of molten iron.

B. Improve sand peel from casting at shakeout.

C. Produce smoother, cleaner casting surface.

D. Minimize imperfections, casting losses, scrap.

II. Additive Theories

A. Gaseous Cushion Theory

During pouring, the gases given off from the carbonaceous additives form a gaseous film which prevents the molten metal from making direct contact with the clay-coated sand grains, reducing sand-metal contact and consequently burn-on.

B. Lustrous Carbon Theory

When heated, the carbonaceous materials provide volatile, hydrocarbon gases which then pyrolyze to deposit a lustrous carbon graphitic layer in the metal-mold interface region. This deposition acts as a physical barrier to iron silicate formation as well as not being readily wetted by molten iron. The combination effect is to inhibit burn-on and penetration.

C. Reducing Atmosphere Theory

When the carbonaceous materials are heated they create a mold atmosphere of reducing gases. This atmosphere keeps the surface of molten iron at the interface free from oxidation, thus preventing formation of the iron silicate necessary for penetration and burn-on.

III. Imperfections

A. Burn-on: Sand grains firmly bonded to casting.

B. Burn-off: Casting surface has rough, sandy appearance.

C. Metal penetration: Metal penetrates into voids between sand grains forming fused mass of metal and sand, casting difficult to remove.

D. Pin holes, caused by high nitrogen content.

IV. Seacoal

A. Highly volatile bituminous coal.

B. Most popular carbonaceous additive to gray iron castings.

C. Additive level about 1.0 - 3.0% of total sand.

D. Add about 0.1 - 0.8% new seacoal to total sand mixture with each recycle.
E. Mold Effects

1. Increased green strength.
2. Increased dry strength.
3. Decreased hot strength.
4. Decreased permeability.
5. Increased moisture required.
6. Increased mold hardness.

F. Drawbacks

1. Low lustrous carbon content, 8-10%.
2. Slow volatile gas evolution.
3. Ash and acidic residues left in sand.
4. High dust, smoke and fumes in foundry.

V. Gilsonite

A. Supplement/substitute to seacoal.

B. Lower ash, lower sulfur.

C. Faster volatile release.

D. Higher lustrous carbon content, 35-38%.

E. 1 part Gilsonite replaces 3 parts seacoal with same or better performance.

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<th>Additive</th>
<th>Foundry Sand Additives</th>
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<td>Blank</td>
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<td>Additive Level (%)</td>
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Additive Properties

| Ash, % | 7.7 | 0.2 | 0.3 | 0.1 |
| Sulfur, % | 1.0 | 0.2 | 0.3 | 1.4 |
| Fixed Carbon, % | 59.1 | 68.5 | 27.7 | 34.0 |
| Lustrous Carbon, % | 10.0 | 38.0 | 35.0 | 38.0 |

Green Sand Properties

| Compactibility, % | 41.5 | 41.5 | 41.1 | 41.2 | 40.3 |
| Moisture, % | 2.40 | 2.65 | 2.68 | 2.60 | 2.50 |
| Density, Kg/m³ | 1539 | 1538 | 1579 | 1573 | 1546 |
| Permeability | 161 | 118 | 97 | 123 | 132 |
| Green Compression, N/cm² | 15.2 | 16.3 | 17.9 | 17.5 | 16.8 |
| Splitting Strength, N/cm² | 3.0 | 2.8 | 3.2 | 3.3 | 3.0 |
| Friability, % | 1.07 | 13.3 | 8.8 | 8.9 | 13.0 |

Dry Sand Properties

| Dry Compression (197.2°C), N/cm² | 42.1 | 49.6 | 69.6 | 64.8 | 50.3 |
| Baked Compression (204.4°C), N/cm² | 39.3 | 46.9 | 136.5 | 80.7 | 53.8 |