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Thermax® in Taphole Clays

Thermax® N990 medium thermal carbon black is manufactured by the thermal decomposition of natural gas. The thermal process provides a unique carbon black characterized by a large particle size and low structure. Thermax® N990 is widely used in applications that require excellent dispersion as well as superior heat, oil, and chemical resistance.

Carbon is used in taphole clays to increase thermal shock resistance as well as corrosion and erosion resistance. Due to increasingly stringent health regulations, traditional binder tar, with carcinogenic and detrimental effects, is being replaced by a lesser carbon-containing binder, phenolic resin, decreasing the carbon content of the taphole clay. Traditionally graphite is used as an additional carbon source. Thermax® N990, at carbon purities above 99.5%, is a high carbon-content alternative carbon source for taphole clays.

The benefits of using Thermax® N990 in taphole clays are:

- Decreased porosity
- High corrosion and abrasion resistance
- Limited shrinkage
- High flow of clay mixture
- Increased cold crushing strength
- Unaffected bulk density

The following study conducted by Cancarb Limited demonstrates the benefits of using Thermax® N990 in taphole clays as a graphite replacement. The taphole control mixture composition can be found in Table 1. Up to 75% of the graphite was replaced with N990. Additionally, testing was completed with N774 furnace grade carbon black to evaluate the effects of particle size. Based on the study results, it is recommended that up to 50% of the graphite loading be replaced with N990 to improve taphole clay properties.

Table 1. Taphole control mixture composition

Calcinated Bauxite	10%
Quartzite	12.5%
Silicon Carbide	5%
Graphite	**20%**
Pyrophyllite Clay	10%
Silicon Nitride	5%
Raw Kyanite	10%
Sillimanite Sand	20%
Kaolinite Clay	5%
Zirconia	2.5%
Si Metal	2.5%

Detailed test results are provided in the figures on the following pages.

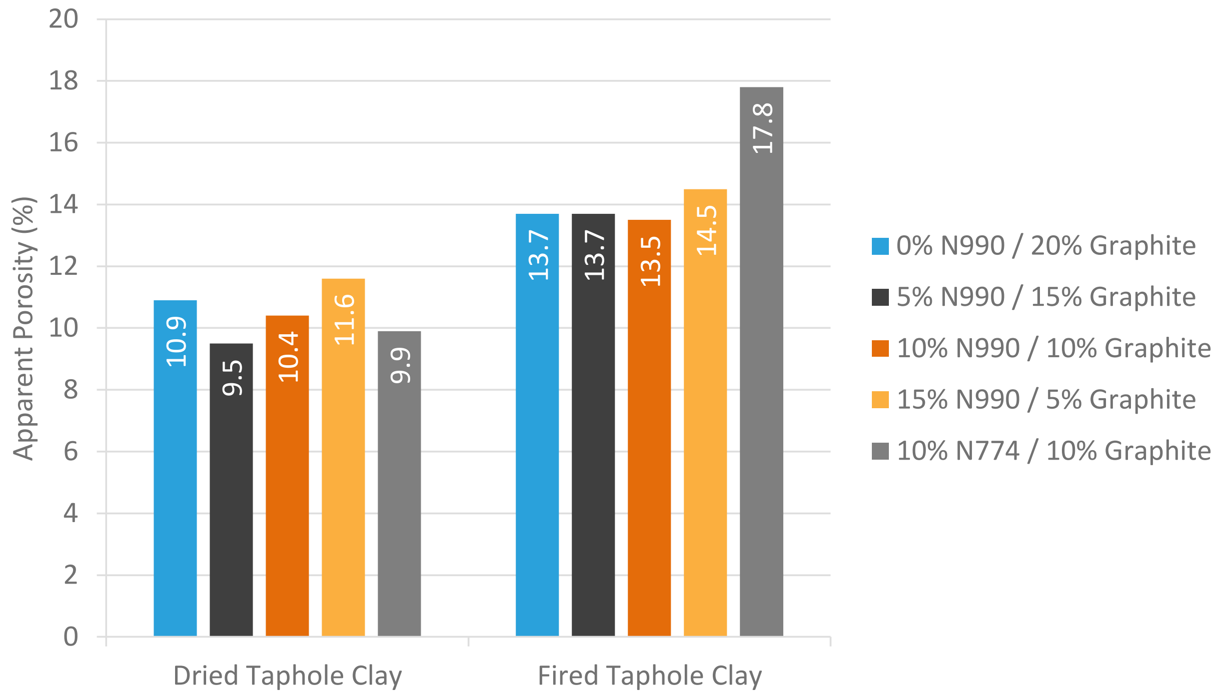

Figure 1. Apparent porosity of dried and fired taphole clay samples. Up to 50% graphite replacement with N990 led to an improvement in apparent porosity. It can also be seen that the larger particle size of N990 provided lower porosity in the fired samples as compared to the furnace grade black N774.

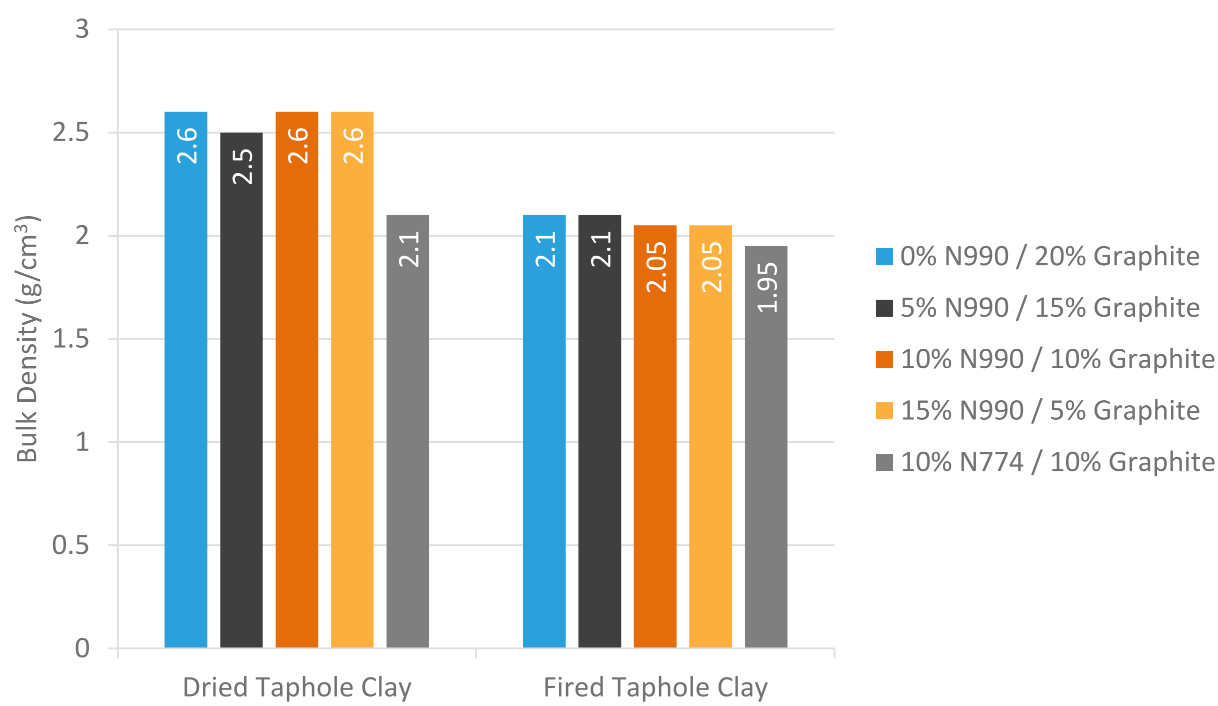

Figure 2. Bulk density of dried and fired taphole clay samples. There were no significant changes in bulk density at any N990 loading. The introduction of N774 tended to decrease the bulk density of the samples.

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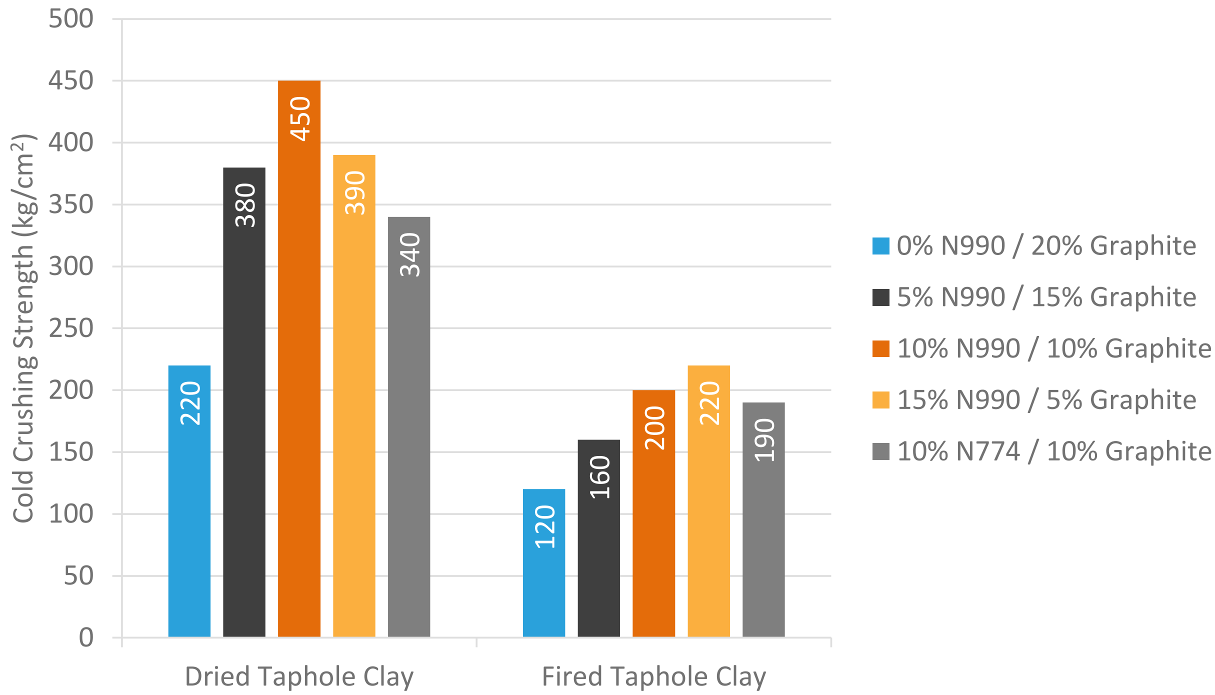

Figure 3. Cold crushing strength of dried and fired taphole clay samples. Cold crushing strength was significantly increased with the introduction of N990 to the composition. The largest improvements in strength were seen with 10% and 15% N990. Cold crushing strength is indicative of abrasion resistance and resistance to slag attack.

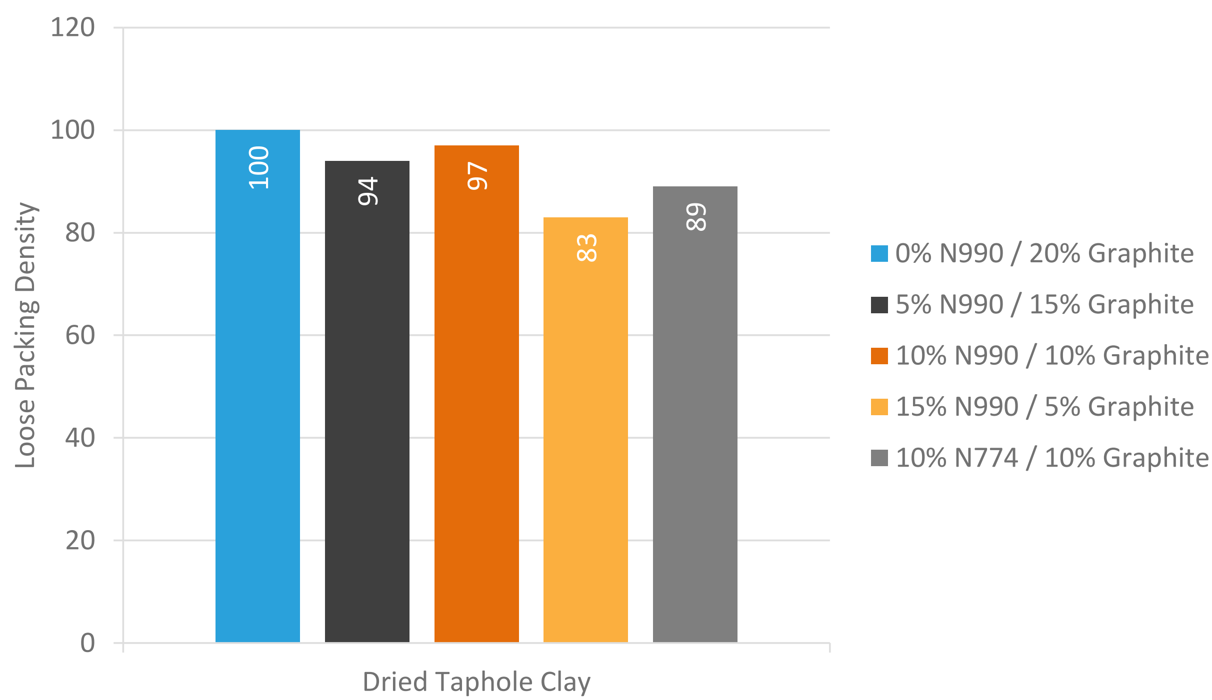

Figure 4. Loose packing density of the dried taphole clay samples. At up to 50% graphite replacement with N990, loose packing density was not significantly impacted.

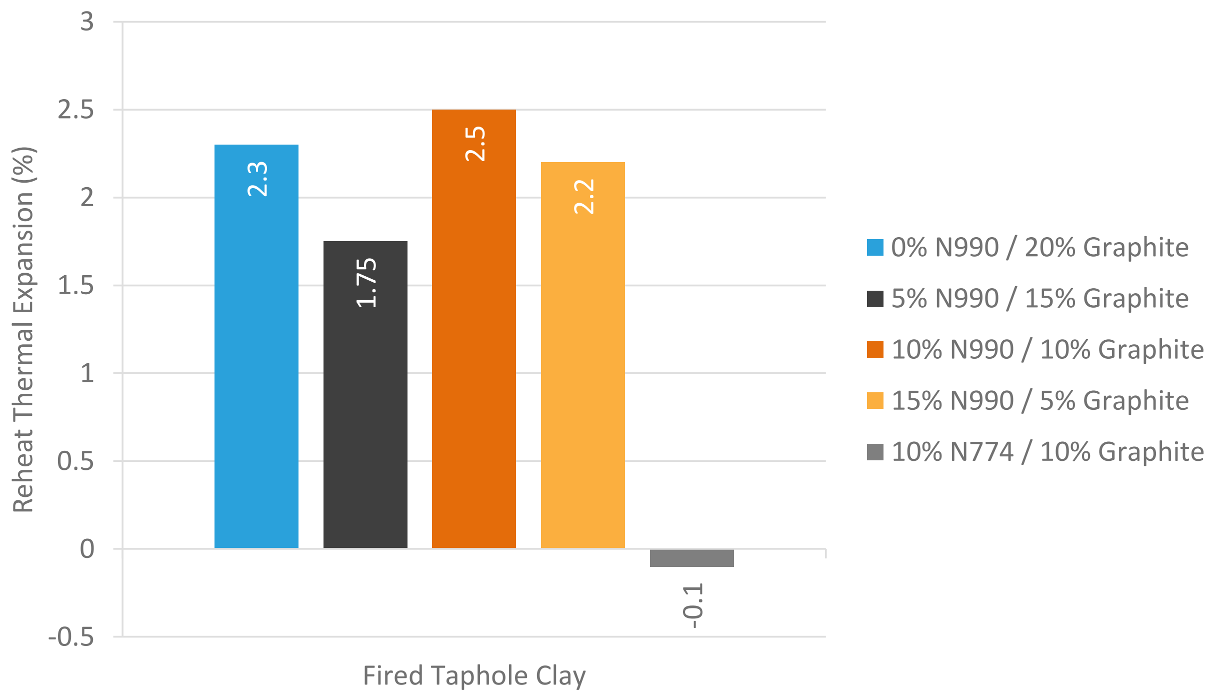

Figure 5. Thermal expansion of the fired taphole clay samples. Thermal expansion remained under 2.5% for all samples.

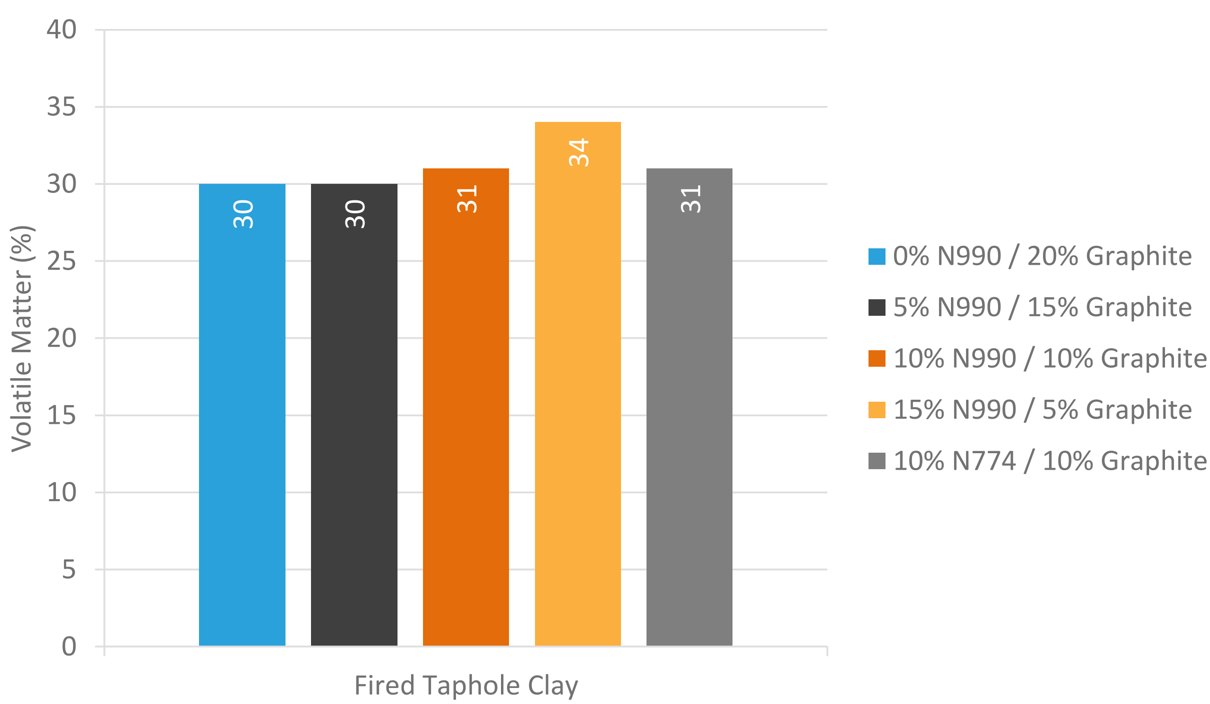

Figure 6. Volatile matter of the fired taphole clay samples. Volatile matter was determined using thermal volume expansion testing. Volatile matter was not significantly affected by the carbon black additions.