Metallurgical coke is a carbon material resulting from the manufactured purification of multifarious blends of bituminous coal. In its natural form, bituminous coal is soft; its medium-grade composite contains a high occurrence of unstable components. The majority of the unstable components are either reclaimed or recycled. Both blast furnace coke and foundry coke are made by baking a blend of selected coking coals in certain high temperature without contact with air until almost all of the volatile matter is driven off. The resulting product, coke, consists principally of carbon, as listed in above table. By-products are crude coal tar, light oils, and ammonia, etc.

Generally speaking, chemistry, size, and strength have been considered the most important properties for use in the blast furnace. Other important factors are coke reactivity and CSR (coke strength after reactivity), which deal with the amount and size of pores and walls, porosity, and density. Carbon textures and micro structure are two main factors that affect the reactivity, stability, and the coke strength after reaction.

To produce high quality blast furnace coke, high quality coals must be used and properly mixed. High quality coals are those coals that, when coked together, produce the highest "stability" and CSR to support the blast furnace burden and allow maximum wind for maximum production. Chinese coke is reportedly having higher CSR in comparison with the steel manufacturer.

Low Ash Metallurgical Coke (Met Coke) is required for metallurgical and chemical industries and is used as the primary fuel where high temperature and uniform heating is required. The industrial consumers of LAMC include integrated steel plants, industry/foundries producing Ferro Alloys, Pig Iron, Engineering Goods, Chemicals, Soda Ash and Zinc units etc.

### Processing

Metallurgical coal is used in the production and purification of metallurgical coke. It is during the heating process that the unstable components are released. The final product is a non-melting, solid, stable carbon. However, the "ash" elements, which were part of the original bituminous coal, remain encapsulated in the resultant met coke. One attribute of met coke is its ability to burn while producing little or no smoke

### Important Properties of Metallurgical Coke

#### Physical Properties

A high quality coke is characterized by a definite set of physical and chemical properties that vary within a narrow limit thereby ensuring consistency in the quality. Coke is the only solid material remaining below the cohesive zone in the blast furnace. Hence, coke must provide the strength to support the burden and create the void spaces required to maintain the permeability of the bed. Hence, for stable blast furnace operation, the physical properties of coke are of paramount importance. A large mean coke size with narrow size variations helps to maintain a stable void fraction for the flow of gases and molten products and consequently improves the blast furnace operation and is mostly controlled by proper screening. In terms of coke strength, the stability and coke strength after reaction with CO₂ (CSR) are the most important parameters. The stability measures the ability of coke to withstand breakup at room temperature and reflects coke handling behaviour outside the blast furnace and coke breakage in the upper part of the blast furnace. CSR measures the potential of the coke
breakage under the high temperature CO2 environment which exists throughout approximately 2/3rds of the blast furnace volume. If the coke reacts excessively in the blast furnace with CO2, it will weaken and degrade into smaller particles. These smaller coke particles will have the negative results as of charging small coke resulting in low permeability, poor flow of gases and molten products and reduce the blast furnace productivity. CSR and stability are primarily controlled by coal properties and only secondarily by coke oven.

**Chemical Properties**

With physically stable raw materials in the blast furnace, further control of the process is achieved through control of the chemical properties. The most important chemical properties of coke are moisture, fixed carbon, and the content of minor elements.

Moisture affects energy requirements and higher moisture will carry fines that on drying either leaves the furnace top or contribute to the coke fine loading, thereby offsetting the value of controlling the CSR and stability values. Moisture is mostly controlled by battery operations. Fixed carbon is the fuel portion of the coke; the higher the fixed carbon, the higher is the thermal value of coke. Fixed carbon is controlled by the rank of the coal and the amount of mineral matter in the coal. Coke ash content is also critical to blast furnace operation and hot metal quality. As the total ash increases or varies, the available fuel, carbon, decreases or varies which negatively affect the amount of energy and reducing gases available. Higher ash also results in a higher amount of slag, which requires extra energy to melt. Since ash is predominantly acidic, as it increases, additional flux is required to maintain constant slag chemistry so that sulfur can be removed. Also, the higher silica will result in higher silicon monoxide gas release during coke combustion and more silicon will be absorbed in the iron; the net result being an increase in hot metal silicon. The overall effect of high ash is more slag, lower metal yield, and less production. Ash is controlled by the coal depositional environment which affects the mode of distribution of mineral matter in coal.

**Application of Metallurgical Coke**

- Met coke is used in products where a high quality, tough, resilient carbon is required. Met coke, limestone, and iron ore are mixed together in high temperature furnaces where extreme heat causes the chemical properties to bond, forming iron and steel. More than 95 percent of the met coke produced is used in the iron and steel industries.

- Besides being used in blast furnace, sinter plant, steel making furnaces and ferro – alloy production, metallurgical coke has many more applications. It is used where a tough and resilient, high quality wearing carbon is needed. Met coke’s applications include for example: friction materials, conductive flooring, foundry coatings, corrosion materials, foundry carbon raiser, reducing agents, drilling applications, ceramic packing media, heat-treatment, oxygen exclusion and electrolytic processes. Met coke can be also used as a filler coke for the poly-granular carbon products.