

Cost-effective substitute for blast furnace coke

PHYSICAL SCIENCES: Materials

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| The Challenge | <p>Around 70% of iron and steel production makes use of coke derived from metallurgical or coking coal. Annual world demand is ~700 Mt, with China and Australia being the major suppliers.</p> <p>Due to the limited (and diminishing) supply of good quality coking coals, coke makes up the costliest component of the blast furnace charge in steel production. Several properties of the coke are important considerations in this application:</p> <ul style="list-style-type: none"> • High compressive strength • Low reactivity • Low levels of minerals and sulphur <p>Current processes for obtaining coke-like materials from brown coals generate a material of sufficient cold strength; however, the measured reactivity is too high and/or the processes are too expensive and wasteful to be commercially viable.</p> <p><i>There is a clear need for new coke substitutes to reduce iron and steel production costs.</i></p> |
| The Solution | Our solution is a substitute for metallurgical coal in blast furnace applications without the availability and cost constraints of current products. Our modified coal-based product has properties very similar to coke and offers the potential to significantly reduce the cost of iron and steel production. |
| Key benefits | <ul style="list-style-type: none"> • Prepared from cheaper and more readily available materials than conventional coking coals • High strength and low reactivity, similar to conventional metallurgical coke • Potential to significantly reduce the cost of iron and steel production |
| Development Stage | Proof of Concept – final stages |
| Brief Description & Differentiation | <p>A new substitute for blast furnace coke based on Victorian brown coal (VBC) that can be used as a cheaper substitute for all or a significant part of the coke charge to a blast furnace.</p> <p>This new process, under specified conditions, gives a product that has properties close to those of a blast furnace coke. A range of binders has been tested, with two performing particularly well (Table 1).</p> <p>Low reactivity of the coke correlates with a high proportion of graphitic structure. Our product has a relatively low reactivity, approaching that of blast furnace coke and has a reasonable proportion of graphitic structure, less than that of a blast furnace coke under the conditions trialed so far, but much higher than that of other low rank coal-derived solid carbonization products.</p> <p>Like blast furnace coke, our new product has a low surface area and micropore volume. Its cold strength is higher than that of blast furnace coke.</p> |
| Research Team | Prof Alan Chaffee (School of Chemistry) |
| Intellectual Property | Australian Provisional Patent application filed (2019). |

Table 1: Properties of Monash substitute products vs. metallurgical coke

| Product | Yield (wt %) | Bulk Density (g/mc3) | True Density (g/cm3) | Compressive Strength (MPa) | Surface Area (m2/g) | Reactivity (modified CRI*, %) |
|---------------------------|--------------|----------------------|----------------------|----------------------------|---------------------|-------------------------------|
| VBC + No Additive | 50 | 1.13 | 2.00 | 100 | 657 | 80 |
| VBC + Additive A | 55 | 1.39 | 2.01 | 250 | 27 | 23 |
| VBC + Additive B | 53 | 1.29 | 2.02 | 29 | 78 | 26 |
| Metallurgical Coke | 75 | 0.87 | 1.90 | 20 | 18 | 13 |