BlueScope Steel (AIS) Pty Ltd

Port Kembla Steelworks Renewables and Emissions Reduction Study

LESSONS LEARNT REPORT #2

Project Details

Recipient Name	BlueScope Steel (AIS) Pty Ltd
Primary Contact Name	Andrew McClure
Contact Email	andrew.mcclure@bluescope.com
Reporting Period	Jul – Sep 22
Date of Submission	9 December 2022

This Project received funding from the Australian Renewable Energy Agency (ARENA) as part of ARENA's Advancing Renewables Program.

EXECUTIVE SUMMARY

At the end of the second quarter of the project, three significant lessons have been identified:

- Biochar has significant capacity to hold moisture, affecting transport efficiency and handling procedures.
- Achieving the target particle size distribution during grinding of biochar will be more difficult than for coal alone and will require changes to the operation of BlueScope's Pulverized Coal Injection (PCI) Plant.
- Pulverized biochar/coal blends show improved flow parameters compared to coal alone.

PROJECT OVERVIEW

Biochar from renewable sources has the potential to replace some of the coal used within an integrated steelworks and thereby reduce Green House Gas (GHG) emissions. With the support of ARENA, as part of ARENA's Advancing Renewables Program, BlueScope is looking to conduct trials to assess the risks of the pneumatic conveyance of biochar, mixed with pulverised coal, for injection into the blast furnace. Pilot trials are to be conducted at the Bulk Materials Engineering Australia's test facility at the University of Wollongong. Following the pilot testing, plant trials are to be conducted at the Port Kembla Steelworks (PSKW), where different ratios of biochar will be mixed with pulverised coal, pneumatically conveyed to No.5 Blast Furnace, and injected through the tuyeres.

KEY LEARNINGS

Lesson learnt No.1: Dustiness and water holding capacity of biochar

Category: Biochar handling/logistics

Objective: This lesson is about the handling characteristics and moisture holding capabilities of biochar.

Detail: In order to conduct the trials following pilot testing, BlueScope needed to secure sufficient biochar of suitable quality (low ash and volatile matter). Eight hundred and fifty tonnes of biochar from 2 suppliers have now been delivered to PSKW. In receiving deliveries of biochar, it has become evident that biochar handling can be challenging. At low moisture levels, the fine (-6mm) biochar from our largest supplier becomes extraordinarily dusty. Furthermore, the low density of the biochar means that the dust takes considerable time to settle out of the air necessitating the use of significant water to prevent emissions. However, it was found that biochar has significant capacity to hold water, up to at least 45% by mass (in comparison to a maximum of ~15% for coal), which in turn becomes problematic for its future use in the PCI Plant. As such, it has taken some time to determine the balance between dust generation and moisture additions, with indications that for the fine biochar material, approximately 13-18% moisture is required to control dust levels. In addition to the difficulties controlling dust, following significant rain at the manufacturing facility, fine biochar was arriving with very high moisture levels, significantly reducing the transport efficiency of biochar deliveries. As such, the moisture holding capacity of biochar will need to be considered for the trials but also for future storage, handling, and transport of biochar, should it occur.

Conclusion: Fine biochar can be very dusty and difficult to handle at low moisture levels, but moisture additions need to be carefully controlled to prevent moisture levels reaching excessive levels. The proportion of moisture is something that will need to be seriously considered for future storage, handling and particularly transport for future biochar usage, should it occur.

Lesson Learnt No.2 – Biochar Grinding Performance

Category: Biochar properties/PCI Plant Operation

Objective: This lesson is about the grinding performance of biochar and the necessity for changes to the PCI Plant to ensure that the target particle size distribution is achieved.

Detail: Preparation of biochar/coal blends was key to enabling pneumatic conveying tests at the Bulk Materials Engineering Australia's test facility. Part of this preparation required the grinding of a biochar blend in a mill similar in design (though much smaller in scale) to that at BlueScope's PCI

Plant. Grinding of the biochar appeared to be problematic as it was difficult to achieve the target particle size (80% -90µm) under standard conditions due to the differences in biochar properties compared to coal. Despite adjusting the mill to compensate for the difference in properties, the final ground biochar was still somewhat coarse. As such, this shows that larger changes than expected in grinding pressure, classifier speed and perhaps feed rate will most likely be required at the PCI Plant to ensure that the target particle size distribution for the biochar/coal blends is achieved.

Conclusion: PCI Plant mill setting will need to be adjusted more than expected to ensure that the biochar component of the coal/biochar blend is ground sufficiently to ensure that the overall target particle size distribution for the pulverized coal/biochar blend is met.

Lesson Learnt No.3 – Biochar/Coal Blend Flowability Parameters

Category: Biochar/Coal Blend Properties

Objective: This lesson is about the handling characteristics of the pulverized biochar/coal blends as determined by standardised testing.

Detail: Due to the difference in density and particle morphology between pulverized coal and biochar, BSL were concerned that the pneumatic conveying performance of biochar/coal blends would be significantly degraded, negatively impacting the operations of the PKSW PCI Plant and therefore the Blast Furnace. As such, pilot-scale trials of biochar/coal blends at the Bulk Materials Engineering Australia test facility were necessary to mitigate these risks. These trials are a key part of the ARENA funded project and to date a significant proportion of the testing has been completed. While results are yet to be fully analysed, static testing shows that biochar/coal blends show similar or slight improvements in several material flow related parameters when compared to coal. As such, while further results are still pending, indications are that biochar/coal blends will be easier to handle and therefore should convey as easily as coal alone, thereby limiting the potential impacts on the operation of the PCI Plant and Blast Furnace. This is contrary to expectations given that the particle shape of ground biochar is quite different to that of coal, being more needle-like and therefore potentially prone to binding.

Conclusion: Contrary to expectations, based on standardised static testing ground, biochar/coal blends appear to flow in a similar manner or slightly better than coal alone.