AKF5 – Tyre Derived Fuel (Used Tyres)

1. Background

1.1. Resource Recovery Opportunities

In March 2020, the former Council of Australian Governments (COAG) announced a ban on the export of waste plastic, paper, glass and tyres. The purpose of the ban was to prevent the export of unprocessed waste which will likely have a negative environmental or health impact in the importing countries; to encourage Australian companies to take greater responsibility for the waste produced in Australia; and to develop Australia's capacity to recycle material and produce high value products with recycled content. The ban was legislated under the *Recycling and Waste Reduction Act 2020* (RAWR Act).

From 1 December 2021, all baled whole tyres or tyres in pieces larger than 150mm were banned from export. From 1 December 2021, a waste export licence is required to export the following waste tyres:

- Passenger, SUV, bus, truck and aviation (BTA) for re-treading to a verified re-treading facility;
- Tyres that have been processed into crumbs, buffings, granules or shreds;
- Tyres to an appropriate importer for re-use as a second-hand tyre; and
- Tyres that have been processed into shreds of not more than 150mm for use as tyre-derived fuel (TDF).

Tyres are essential components of an economy and are used across almost all industries in Australia. Australia generates approximately 466,000 tonnes of End of Life Tyres (EOLT) annually, with around 259,000 tonnes historically recovered for export.

As a result of this ban, there is an increased demand domestically to find markets for waste tyre products.

Most waste tyres are collected through Australian tyre retailers and industrial users. Tyres may be processed into several waste tyre products. The definition, source material and likely end uses of each waste tyre product is outlined in the table 1 below.

Table 1: Waste Tyre Products

Waste tyre product	Definition	Source material	Likely end uses
TDF (Tyre Derived Fuel)	TDF are shredded (generally to 50mm-150mm) waste tyres which serve as an alternative fuel source.	Primarily whole passenger tyres, but BTA (bus, truck and aviation) and OTR (off-the road) tyres can also be processed with the appropriate equipment.	Alternative fuel source, likely to be used in industrial processes including as boiler fuel, paper mills and cement kilns.
Rubber crumb/ powder, granules or buffings	Rubber granule: 2-15mm rubber. Fibre and steel has been removed from the rubber product.	Primarily bus and truck tyres due to a high natural rubber content compared with passenger tyres. There is limited domestic capacity to crumb OTR and AV tyres.	• Playground surfaces • Sporting mats • Sporting fields • Acoustic mats • Anti-slip mats • Equestrian surfaces
	Buffings: rubber component only cut to a <2mm size. Fibre and steel has been removed from the rubber product.	Derived from BTA tyres during the re-tread process.	• Matting • Moulded products
	Crumb rubber or powder: Very small pieces of rubber with no contaminants <.7mm	Primarily BTA tyres due to a high natural rubber content.	Used in industrial processes including spray on bitumen roads and additive to asphalt mix. • Adhesive tile glue • Bitumen and asphalt aggregates (road surfaces)
Whole tyres for re-tread	A whole tyre that has good structural quality where the tyre casing remains intact but the tyre tread requires renewed tread and sidewall rubber.	BTA and OTR tyres. Passenger tyres are not designed to be re-tread.	Re-used as a BTA tyre. Re-tread process can be repeated more than 3 times depending on the quality of the casing[1]
Whole tyres for re-use	Whole tyres that have been discarded but still capable of being used.	Primarily passenger and OTR tyres.	Exported to countries with lax regulations for re-use as passenger, OTR or BTA tyres.

2. Material Specifications

2.1. General Material Description

Alternative Kiln Fuel 5 (AFK5), Tyre Derived Fuel is derived from used and rejected passenger vehicle and truck tyres that have reached the end of their useful lives.

Used passenger vehicle and truck tyres are collected from various sources such as retail tyre fitting outlets. and Tyres suitable for re-use (such as re-treaded tyres) are diverted to those uses.

The manufacture of tyres is a very carefully controlled process to ensure that the tyres meet the required quality and safety standards. **As such, there are only very minor changes to the chemical properties of tyres during use.**

The main constituents of used tyres are natural and synthetic rubber hydrocarbons, carbon black, oils, steel belts and beads, zinc oxide and sulphur. There are minor variations in these components depending on the use, size and quality of the tyres.

Used tyres currently present a major disposal issue in all developed countries including Australia.

2.2. Used and Rejected Tyre Sources

Tyre resource recovery facilities that can produce AKF5 tyre derived fuel, source their used tyres from a number of commercial and retail tyre outlets. These include:

- Motor garages
- Retail tyre outlets
- Commercial vehicle fleet facilities
- Road transport fleet facilities

AKF5 will not be sourced directly from these sources but through licensed operators who operate systems to collect the tyres from these sources and process them to the AKF5 specification for use at Berrima. All tyres will be sourced from accredited tyre recyclers who source from accredited tyre collectors under the Tyre Stewardship Australia Accreditation.

2.3. Components and Contaminants

AKF5 Tyre Derived Fuel will represent the components used in the tyre manufacturing process and typically consists of :

- Natural and synthetic rubber (hydrocarbons).
- Carbon black (fine carbon)
- Oils and waxes (hydrocarbons)
- Polyester, nylon and rayon - as fabrics in carcass, plies and chafer (hydrocarbons)
- Sulphur
- Zinc oxide
- Steel - as steel wires in steel belts and beads
- Silica - fine particles of sand
- Lime - fine particles of calcium oxide
- Minor components including:
    - copper, tin and chrome – used to coat steel wires to control corrosion
    - colouring agents and dyes
    - other organic compounds used to ensure tyre properties.

The manufacture of tyres is a very carefully controlled process. The content of these components are very tightly controlled during the manufacture of new tyres to ensure that they meet the required quality, safety and performance requirements specified in standards and manufacturers specifications. There are minor variations in the components and manufacturing process for the different tyre types. However, these minor variations have no effect on the tyre derived fuel.

There are only very minor changes to the chemical properties of tyres during use. The predominant change is physical and is predominately the loss of rubber from the wearing tread.

The main potential contaminants are dirt and water through their use on roads. The use of tyres collected direct from the commercial and retail sources results in low levels of contaminants.

2.4. AKF5 Suppliers

Berrima cement works will only accept delivery of AKF5 sourced from EPA licensed tyre resource recovery facilities who operate a quality assurance system. As described in Section 2.2, it is a minimum requirement that accredited tyre recyclers source from accredited tyre collectors under the Tyre Stewardship Australia Accreditation.

Any supplier proposed to be engaged for the supply of AKF5 to the Cement Works will be contractually required to maintain an appropriate quality control/quality assurance (QA/QC) procedure to ensure that the supply of AKF5 Tyre Derived Fuel meets the requirements of the AKF5 specification presented in Appendix 1.

The supplier QA/QC procedures will define processes for controlling the quality of raw materials and the testing and processing stages to be followed to ensure compliance with the AKF5 specification.

The supplier QA/QC procedures will be audited annually in order to demonstrate that the supplier is complying with these procedures.

2.5. Specification

Tyres are a carefully controlled product made to strict quality standards which means there is very little variation in the composition of tyres sourced for AKF5. This ensures a consistent quality of tyre derived fuel.

The specification shown in Appendix 1, is for Boral's internal quality assurance purposes and indicates the expectations on suppliers to meet. The specific minimum calorific values and chlorine content % by weight within the specification reflect requirements within the sites development consent for non-standard fuels.

2.6. Material Variability

- Between Suppliers

Tyres are a carefully controlled product made to strict quality standards. This ensures there is minimum chemical quality variation of tyre derived fuel between suppliers.

- Within Batches

Tyres are a carefully controlled product made to strict quality standards. This ensures there is minimum chemical quality variation of tyre derived fuel within batches.

- Between Batches

Tyres are a carefully controlled product made to strict quality standards. This ensures there is minimum chemical quality variation of tyre derived fuel between batches.

- Seasonal Variations

Tyres are a carefully controlled product made to strict quality standards. Tyre sales are largely constant during the year so there is minimum chemical quality variation of tyre derived fuel during the year.

3. Effect of Material Variability on Kiln Performance and Emissions

Tyres are a carefully controlled product made to strict quality standards. This ensures that there is minimal variation in the chemical property of the tyre derived fuel.

Critical to the operation of the kiln and maintenance of clinker quality is a constant input of fuel and materials. The system for feeding the tyre derived fuel to the kiln is designed to ensure a constant fuel input. Such systems are well proved at other cement plants. They have been found to be reliable and ensure stable kiln operation and product quality.

This, coupled with the lack of variability of the tyre derived fuel, ensures stable kiln operation and minimises any effect on emissions.

3.1. Transport and Delivery

AKF5 is delivered to the Berrima Works by road transport.

Transport and delivery arrangements will be confirmed by the Production Manager/Technical Manager to meet production requirements.

The driver shall proceed to the weighbridge and enter the load details into the weighbridge system. The driver shall follow site procedures to ensure gross and net weights for the vehicle and delivered product weights are registered in the weighbridge computer system.

The driver shall then proceed to the nominated discharge point and unload.

The frontend loader operator will co-ordinate with truck drivers the unloading of AKF5 in the defined AKF5 storage area.

4. Berrima Site Facilities

The facilities for the handling and storage of AKF5 are approved and have been constructed to comply with the requirements of the NSW Fire Brigades Guidelines for the Bulk Storage of Rubber Tyres.

4.1 Fire and Emergency Facilities

The storage area has access to a fire hydrant for the rapid extinguishing of fires.

Procedures for fire, spills and vehicle incidents are included in the site Emergency Procedures Manual.

5. Quality Control Procedures

Tyres are a carefully controlled product made to strict quality standards. This ensures there is minimum chemical quality variation of tyre derived fuel. The physical properties of the shreds (size, exposed wires) are more important for feeding of the fuel and maintaining constant fuel input.

The supplier will sample and test a **monthly composite sample** as per the Specification in Appendix 1. Tests will be undertaken by an independent NATA accredited laboratory.

5.1. Batch Size

Tyre derived fuel is produced in a continuous process. Batch size is not applicable.

5.2. Pre-delivery procedures

There are no pre-delivery approval procedures requirements for tyre derived fuel.

5.3. Delivery approval

There are no delivery approval procedures requirements for tyre derived fuel.

5.4. Post-delivery procedures

Procedures for storage and use of AKF5 are included in the Berrima Laboratory Quality Manual.

The Technical Manager or delegate will compare the test results from the independent laboratory against the specification and report any non-conformances to the supplier for action.

6. Quality Assurance and Auditing

Boral operates a quality management system (QMS) certified to ISO 9001:2000 by BSI Global.

The procedures for AFK5 shall be included in the routine auditing of the system and the results of the audits will be included in the management review.

Any non-compliance shall be reported through the QMS Non-conformance System.

Boral will also conduct annual audits of the tyre derived fuel supplier quality management system.

6.1 Emergency Procedures

Emergency procedures for spills and vehicle incidents involving AKF5 are included in the site Emergency Procedures Manual.

6.2. Off Specification Deliveries Procedures

The careful control of the tyre manufacturing process together with the stockpiling and blending of the tyre derived fuel minimises the potential for the production and despatch of off specification material. The design of the AKF5 feed system will allow off specification material be used in the production process.

If off specification material is detected the incident will be reported to the supplier for investigation and action. The incident will be reported and investigated through the Boral QMS non-conformance system.

6.3 Records

The following records will be kept and the personnel responsible for maintenance.

Delivery Details – these are recorded in the computerised weighbridge system. The information recorded is:

Record	Comment
Docket no.	Generated by computer
Customer:	Entered by driver
Fleet:	Generated by computer if truck registration
Registration no:	Entered by driver
Carrier	Generated by computer if truck registration
Date	Generated by computer
Time In	Generated by computer
Product	Entered by driver
Gross Weight	Generated by weighbridge
Tare Weight	Generated by weighbridge
Net Weight	Generated by computer

This information is held within the computer system and is available through the information system. The records are used to check and verify deliveries and raise invoices.

Monthly Analyses – Technical Manager or delegate (Laboratory Analyst)

Audit Results – Technical Manager or Environmental Manager

Non-conformance Reports – Technical Manager

Appendix 1: Specification AKF 5 – Tyre Derived Fuel (Used Tyres)

Parameter	Units	Typical
Gross Calorific Value	MJ/kg	26.3 minimum*
Moisture Content	% by wt	<2%
Particle Size	mm	Up to 50mm X 50mm (approximate)
Ash Content	% by dry wt	Approx. 12%
Dirt/Foreign Material	% by dry wt	<2%
Total Sulphur	% by dry wt	<2.5%
Total Chlorine	% by dry wt	<1% Maximum**

*The MJ/kg aligns to the National Greenhouse and Energy Reporting (Measurement) Determination – 13 August 2021 NGER Amendment (2021 Measures No.1) Regulation 2021, NGERs Item 8 – TDF – Tyres Derived Fuel.**Maximum allowable within the Berrima Cement Kiln 6 Development Consent No. 401-11-2002-I Condition 3.21 d).

Note: As per condition 3.21 e) of the Berrima Cement Kiln 6 Development Consent No. 401-11-2002-I, AKF5 must not be diluted or blended with other materials to meet any of the fuel specification requirements