

Examining the Bauxite Residue Management Framework in Jamaica

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Abstract



In Jamaica, the proximity of bauxite and alumina operations to communities creates a particularly critical context for the environmental risks associated with the bauxite residue disposal sites. Additionally, the protection of water supply as a consequence of the geological setting and potential impacts on the watersheds are high priority objectives of the nation. The recent severe incidents in Hungary (Ajka) and Brazil (Brumadinho) have brought particular attention to the geotechnical engineering of the tailings sites. This has financial implications for the companies and the country, as well as for the sustainability of the local mining industry and associated processing operation. This also creates some governance challenges if the ownership of operations changes and results in differences in operational approaches. There is large variability in local regional geology, dam construction techniques, tailings properties and treatment. Though the general concepts of risk assessment are tacit, changes in global attitudes, seasonal climatic variations and environmental legal obligations are evolving. Further, for a mature industry these issues should be considered in light of current closure objectives. The utilization of bauxite residue is currently only modest, 3-4 % of the tonnage generated globally, but is being extensively investigated by many companies and universities, often with substantial national funds such as the European Union (EU), and is widely accepted to become more important with global trends towards the circular economy as alumina producers become more conscious of the importance of ESG.

Keywords: Bauxite residue management, Red mud, Governance, Risk assessment

1. Introduction

Jamaica had five refineries extracting alumina from bauxite: Jamalco, Ewarton Works, Alpart, Kirkvine Works and Revere. Only the first two refineries are currently in operation. JISCO Alpart suspended operations in 2019, and Kirkvine Works has not reopened since 2009 when the operations were halted during the worldwide economic crisis. The fifth, Revere, was closed in 1975 and the refinery dismantled. Each refinery has its own bauxite residue (red mud) disposal site or sites and consequently there are three operational bauxite residue disposal areas on the island. The inactive areas are at Revere and the ponds associated with the former Alcan operations located at Kirkvine, and Mount Rosser. The Alcan ponds at Kirkvine are closed and the Mount Rosser Pond which straddles the St. Catherine/ St. Ann parish border is in the closure phase.

The areas where bauxite is located, the four (4) alumina refineries, the bauxite residue disposal areas and the Revere area are indicated individually in Figure 1 below by name and location. Geographically the bauxite residue sites can be found in five parishes – St. Elizabeth, Manchester, Clarendon, St. Catherine and St. Ann. The spatial distribution impacts emergent rural towns which have expanded over time in relation to the alumina industry, as well as major waterways and aquifers. Operations in St. Catherine may directly impact the Rio Cobre treatment plant, which is the water supply for Spanish Town, a major populated area close to the capital city of Kingston. Meanwhile, the operations in St. Elizabeth have the potential to impact the water supply for

Mandeville, the capital city for the adjacent parish of Manchester. Operations in Clarendon may impact the Rio Minho.

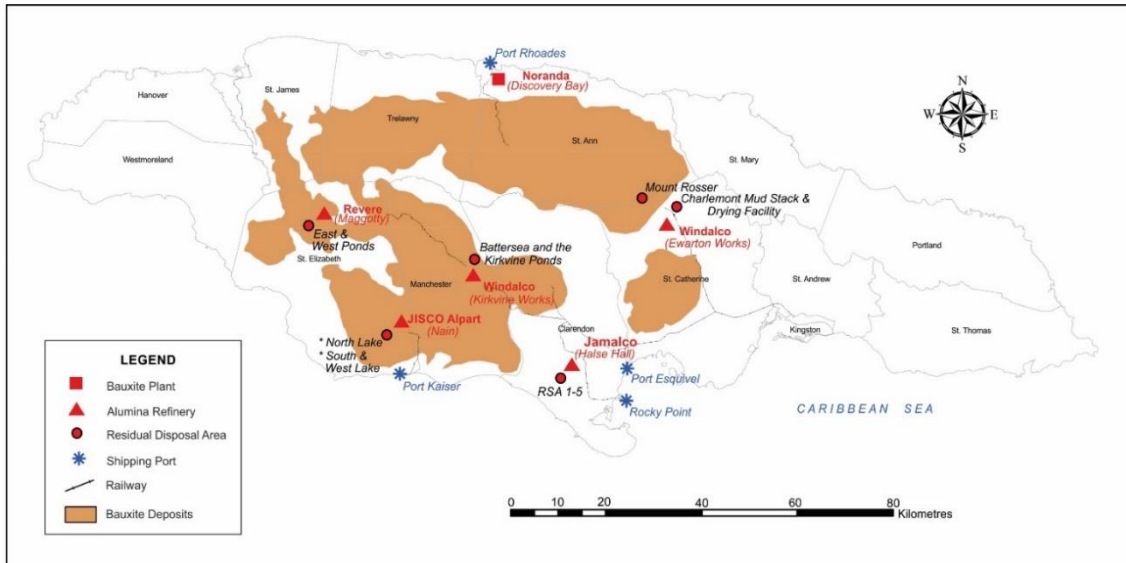


Figure 1. Location of bauxite residue disposal sites in Jamaica.

Jamaican bauxite residues are generated at a ratio of 1 tonne of alumina to roughly 1 tonne of mud; the volumes at each location are estimated and shown in Table 1. This results in a total of approximately 130 million tonnes of bauxite residue stored in residue areas; volumes from each location are shown in Table 1.

Table 1. Current Bauxite Residue Stocks in Jamaica.

Location		Parish	Area (ha)	Volume (Millions Mt)
Kirkvine Works	Kirkvine Ponds and Battersea Mud Disposal Site	Manchester	100 (+ small ponds cumulative area)	22 (+ 3 in old Kirkvine Ponds)
	Mt Rosser Mud Disposal Site	St. Ann/St. Catherine	35	11
Ewarton Works	Charlemont Mud Stack	St. Catherine	100	15
	South/West Lake	St. Elizabeth	220	44
Alpart	North Lake	St. Elizabeth	40	
Jamalco	RSA 1-5	Clarendon	330	40
Revere	East Revere and West Revere Ponds	St. Elizabeth	2	0.6
Total			627	135.6

*Source: Monitoring Reports – where none located, conversion ratios used for reported production. (2020).

4.1 Report Submissions, Requirements and Inspections

Typically, all sites will have annual visual inspections by JBI technical experts, with detailed engineering reviews at longer periods, usually by consultants with the relevant expertise. In light of this request for status reviews, all companies will be engaged for thorough engineering assessments with additional requirements to address evolving environmental risk concerns, such as dam failure analyses, updates to existing hydrogeological models and demonstration of site properties of the residues and engineered structures. It was particularly noted that typically, dam safety reviews had not regularly included failure analyses. All active sites have a number of environmental permits, and this will also be a facet of the detailed audit exercise. Additionally, details of current status of residue disposal areas are part of the biannual environmental review process between the regulating stakeholders (JBI, the National Environment and Planning Agency (NEPA), Water Resources Authority (WRA), the Mines and Geology Division (MGD), the Environmental Health Unit (of the Ministry of Health) (EHU) and Jamaica's engineering agency the National Works Agency (NWA)) and the individual bauxite companies [11].

Moving forward, the approach focusses on:

- Areas of concern that have been identified and monitoring corrective works that are being undertaken. Implementation schedules monitored.
- Piezometers that are non-functional/ inaccessible are important for the management framework. All companies should maintain and measure water elevations and quality.
- Visual inspections annually and engineering reviews at least every five years.

However, this should be done more frequently on dams with safety factor less than design or currently below the international safety requirements.

4.2 Closure Planning and the Circular Economy

The Jamaican approaches to closure planning have been elaborated elsewhere but it bears mentioning that much learning in the governance approach and closure objectives have been documented locally [12] and align with the global ambit for bauxite residue management [13]. Though there are expectations of technology changes on the existing sites, as well as potential lateral and vertical expansions, it is unlikely that a wholly new site would be created for bauxite residue. So, the integrated approach to envision closure objectives at the outset would not likely occur. The integration of the concepts related to a local circular economy is in formative stages, and the most likely prospects would be evaluating the use of bauxite residue in cement or other large scale use. However, challenges are anticipated with the attendant logistics, as the residues, once there is significant moisture content, may be considered hazardous and requiring permits for handling and transport [14].

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