

## BIOLEACHING TO UPGRADE AGBAJA IRON ORE

### Highlights

- Phosphorous bioleaching incorporated in process plant design of Preliminary Feasibility Study
- Independent bioleaching trial significantly reduced phosphorous levels in Agbaja iron ore
- Reducing phosphorous has potential to increase price achieved for Agbaja product
- Process design suggests bioleaching will have minimal impact on capital and operating costs
- Optimisation bioleach testwork underway with specialist consultant

Australian based iron ore development company, Kogi Iron Limited (ASX: KFE) ("Kogi", "Kogi Iron" or the "Company") and its 100% owned Nigerian operating company, KCM Mining Limited ("KCM") are pleased to advise that phosphorous bioleaching has been incorporated in its process plant design for the Preliminary Feasibility Study ("PFS") currently underway for its 100% owned Agbaja Iron Ore Project ("Agbaja" or "Agbaja Project").

University testwork has demonstrated that significantly reduced phosphorous levels in Agbaja iron ore can be achieved through simple bioleaching. The Company has recently commenced Stage 2 phosphorous bioleaching investigative work for the Agbaja Project.

Bioleaching is the extraction of specific metals from their ores through the use of bacteria and has successfully been used in the minerals industry since the mid 1990's.

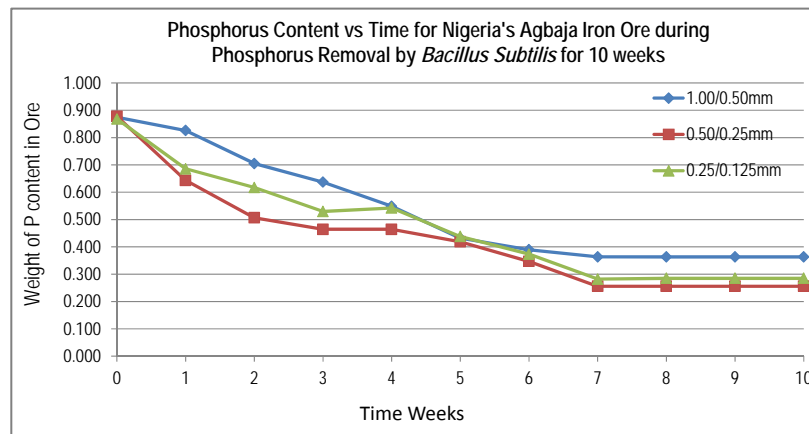
A recent independent University study conducted in Nigeria was successful in reducing the level of phosphorous in Agbaja Plateau iron ore mineralisation from ~0.9% to ~0.25% (refer Figure 1).

The research was published in a paper titled "Laboratory Studies on Phosphorus Removal from Nigeria's Agbaja Iron Ore by *Bacillus Subtilis*" by C. N. Anyakwo and O.W. Obot in the Journal of Minerals & Materials Characterization & Engineering in 2011. The findings of the study stated:

*"Bacillus subtilis has the capability to successfully remove phosphorus from Nigeria's Agbaja iron ore. The result of this research shows that an average of 65.73% P removal across the 3 particle size fractions was achieved. The highest removal of 71.01% P was achieved for 0.50/0.25mm."*



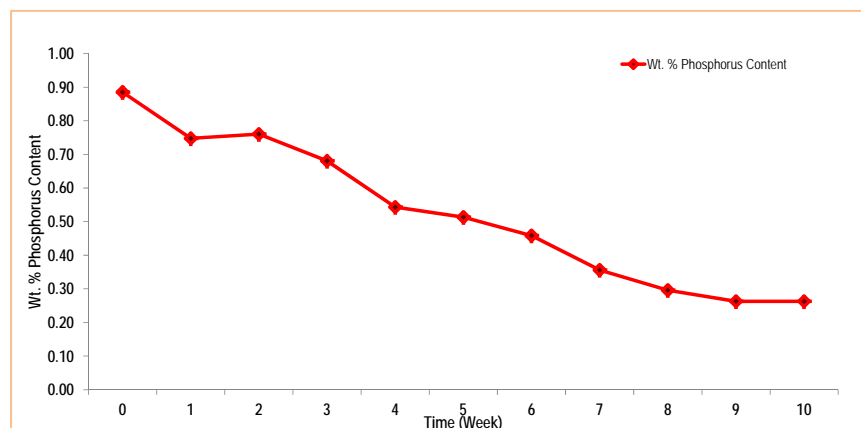
Figure 1 - Laboratory Studies on Phosphorus Removal from Nigeria's Agbaja Iron Ore (2011)



Similar research, in a paper titled "Removal of phosphorus from Nigeria's Agbaja iron ore through the degradation ability of Micrococcus species" was more recently published in the International Journal of Water Resources and Environmental Engineering (2012). The conclusion of this research paper stated:

*The present study on the phosphorus removal from Nigeria's Agbaja iron ore samples using a biological agent, Micrococcus species has revealed positive effects. 69.66% of phosphorus was solubilized by the microorganism.*

Figure 2 - Laboratory Studies on Phosphorus Removal from Nigeria's Agbaja Iron Ore (2012)



Bacterial oxidation specialist Ms Tamsin Senders has joined Kogi Iron's Preliminary Feasibility Study team and has recently initiated bioleaching testwork programs aimed at confirming the findings of the Nigerian University study. The testwork programs are being undertaken by SGS South Africa (Pty) Ltd in Johannesburg under the supervision of Ms Senders, SGS is a leading global inspection, verification, testing and certification company. Results from the Stage 2 test work programs are expected during Quarter 1, 2014.

Kogi Iron's Managing Director, Iggy Tan said: "The Agbaja mineralisation has a number of unique characteristics, including the porosity of the iron bearing oolites, which makes the mineralisation amenable to bioleaching. Bioleaching is used extensively in mineral processing and the potential to apply this simple, low cost processing method at Agbaja is an exciting development."

"The application of this beneficiation process will both broaden the market for the proposed Agbaja concentrate and importantly, increase the net price received. The key to taking full advantage of this opportunity is keeping the process simple which the team has certainly embraced."



## Proposed Process Design

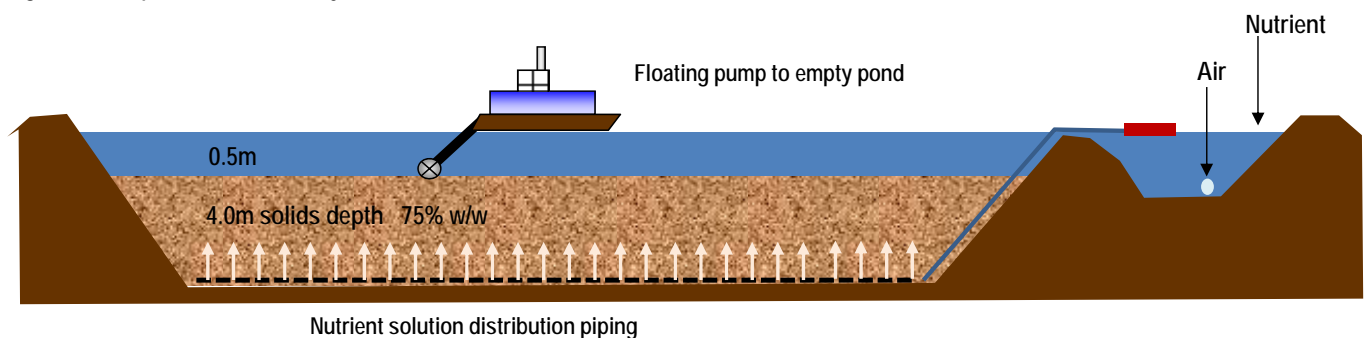
The proposed process design utilises simple bioleach holding ponds, with a nutrient rich aerated solution introduced from the base of the pond, percolating upwards through the iron ore concentration to the surface over time (refer Figure 2).

Concentrate from the processing plant will be pumped into one of eight holding ponds as iron rich slurry and the bacterial culture will be introduced together with the aerated nutrient solution. A total of eight holding ponds of 138m by 138m are envisaged to support a continuous operation. The solids depth in the ponds is proposed at around 3m with a density of ~50% solids. It is proposed that the ponds be lined with 2.0mm thick HDPE liner and geo-synthetic liner, with sloping walls of 3:1 and a total pond depth of approximately 3.5m.

As previously mentioned, the sub-micron particles that will constitute the Agbaja iron ore concentrate are highly porous, allowing the bacterial microbes to easily enter and feed on the phosphorus within the crystal structure. The phosphorus will report to the microbe biomass and solution and will be flushed from the concentrate when leaching is complete.

Aerated solution will be continually pumped into the ponds during the residence period to provide oxygen and nutrients for the microbial cultures during leaching. A bleed stream will be removed from the circulating solution in order to remove metabolites and deleterious elements from the bacterial action. The bleed stream is likely to be able to be used as a rich phosphorous fertilizer, which present opportunities for use such as in mine area rehabilitation work and as a general fertilizer. Once phosphorus levels in the ponds have reduced, the concentrate slurry will be pumped out using a slurry pump mounted on a pontoon. The phosphorous reduced slurry will then be thickened and stored in a tank for pumping down from the plateau to the proposed barge loading facility, at Banda on the Niger River.

Figure 2 – Simple Bioleach Pond System



The proposed design utilises simple and proven pumping technology for the transport of the slurry concentrate and avoids the more traditional and costly heap leach style of bioleaching. The proposed bioleach process is anticipated to have minimal impact on project capital and operating costs.

## Profile – Ms Tamsin Senders

Ms Senders is a Bacterial Oxidation Specialist and has been working in the mining industry for 18 years. Ms Senders has a broad range of experience with expertise in both tank and heap leaching and has represented both mining companies (Titan Resources NL, Fox Resources) and technology providers (BacTech, BioHeap and GeoBiotics). Ms Senders has a strong background in basic and applied research and is a co-inventor on 13 granted international patents, as well as having various papers published in the field of biotechnology/bacterial heap leaching.

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## Reference

### 1. Laboratory Studies on Phosphorus Removal from Nigeria's Agbaja Iron Ore by Bacillus Subtilis

C. N. Anyakwo<sup>1</sup> and O.W. Obot<sup>2</sup>

<sup>1</sup>Department of Metallurgical and Materials Engineering, Federal University of Technology, Owerri, Nigeria

<sup>2</sup>Department of Mechanical Engineering, Faculty of Engineering, University of Uyo, Nigeria.

*Journal of Minerals & Materials Characterization & Engineering, Vol. 10, No.9, pp.817-825, 2011*  
*jmmce.org Printed in the USA. All rights reserved 817*

### 2. Removal of phosphorus from Nigeria's Agbaja iron ore through the degradation ability of Micrococcus species

O. W. Obot<sup>1</sup> and C. N. Anyakwo<sup>2</sup>

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*International Journal of Water Resources and Environmental Engineering Vol. 4(4), pp. 114-119, April 2012*

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## About Kogi Iron (ASX: KFE)

Kogi Iron Limited is a Perth-based company with the objective of becoming an African iron ore producer through the development of its 100% owned Agbaja iron ore project located in Kogi State, Republic of Nigeria, West Africa ("Agbaja" or "Agbaja Project"). The Company is conducting a Preliminary Feasibility Study on a potential iron ore operation at the Agbaja Plateau initially utilizing barging transport of its iron ore product along the Niger River to Warri Port and world export markets. The Company will continue to advance access and usage agreements for an existing under-utilised heavy haulage railway that runs from near the Agbaja Project to Port Warri. This existing railway remains an important part of a longer term transport solution for an expanded production profile.

In recent years Nigeria has sought to diversify its economy, which is dominated by hydrocarbons, into minerals and related industries. Nigeria is the largest country by population in Africa with a GDP growth rate of 7.2% in 2013. The country has very transparent and consistent mining regulations and very favourable fiscal terms for foreign investment in mining.

The Company holds a land position of approximately 400km<sup>2</sup> covering 15 tenements, with the main focus being EL12124 which covers a large part of the Agbaja Plateau. The Agbaja Plateau hosts an extensive, shallow, flat-lying channel iron deposit with Indicated and Inferred Mineral Resource of 586 million tonnes with an in-situ iron grade of 41.3% reported in accordance with the JORC Code (2012). This mineral resource covers approximately 20% of the prospective plateau area within EL12124.



## Forward-looking Statements

This announcement contains forward-looking statements which are identified by words such as 'anticipates', 'forecasts', 'may', 'will', 'could', 'believes', 'estimates', 'targets', 'expects', 'plan' or 'intends' and other similar words that involve risks and uncertainties. Indications of, and guidelines or outlook on, future earnings, distributions or financial position or performance and targets, estimates and assumptions in respect of production, prices, operating costs, results, capital expenditures, reserves and resources are also forward looking statements. These statements are based on an assessment of present economic and operating conditions, and on a number of assumptions and estimates regarding future events and actions that, while considered reasonable as at the date of this announcement and are expected to take place, are inherently subject to significant technical, business, economic, competitive, political and social uncertainties and contingencies. Such forward-looking statements are not guarantees of future performance and involve known and unknown risks, uncertainties, assumptions and other important factors, many of which are beyond the control of our Company, the Directors and management. We cannot and do not give any assurance that the results, performance or achievements expressed or implied by the forward-looking statements contained in this announcement will actually occur and readers are cautioned not to place undue reliance on these forward-looking statements. These forward looking statements are subject to various risk factors that could cause actual events or results to differ materially from the events or results estimated, expressed or anticipated in these statements.

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#### Competent Person's Statements

The information in this announcement that relates to the Mineral Resource for the Agbaja Project is extracted from the report entitled "Mineral Resources at Agbaja Increase 20% to 586MT Includes an Indicated Resource of 466MT" created on 10 December 2013 and is available to view of the Kogi Iron web site [www.kogiiron.com](http://www.kogiiron.com). The Company confirms that it is not aware of any new information or data that materially affect the information included in the original market announcement and, in the case of estimates of Mineral Resources, that all material assumptions and technical parameters underpinning the estimates in the relevant market announcement continue to apply and have not materially changed. The Company confirms that the form and context in which the Competent Person's findings are presented have not been materially modifies from the original market announcement.

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