Leach Time. To establish the effect of leach residence time on recovery, samples of the BIOX CIL feed were leached at varying times. Typical residence time for treating various classes of gold ores ranges between 12 and 48 hours (Stange, 1999). The leach tests were therefore done for leach time of 8, 16, 24, 36, 40 and 52 hours. The leach kinetic data for the tests is graphically represented in Figure 8. The results point to the fact that the BIOX product is relatively fast-leaching with recovery of 79.8 % recorded in the first 8 hours. This is followed by an average increase of 1.6 % per each leach period until a final recovery of 87.92 % after 52 hours.

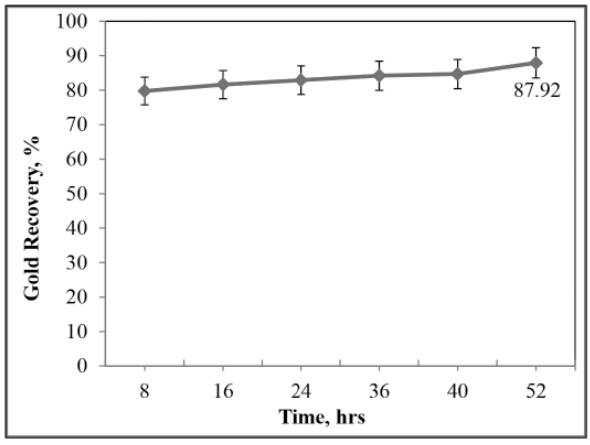

Figure 8. Gold recovery as a function of CIL residence time.

Even though the original design residence time for the Bogoso leach circuit is 35 – 40 hours, the installed capacity was 58 hours (MacIntyre, 2005) due to the availability of existing tanks. This therefore means that the results falls within the installed capacity range of the plant. While there might still be marginal recovery increases beyond the 52 hours, such recovery increases must be high enough to justify the cost of additional tanks in an operation. Further, a prolonged residence time will have a militating effect on recovery as activated carbon fouling will be heightened.

Analysis done by MacIntyre (2005) during the Bogoso feasibility study recommended a residence time of 40 hours because project revenue is diminished with further addition of tanks. The trend of reducing revenue with increasing residence time is shown in Figure 9.

Given the leach results, it turns out to be well placed that the leach circuit was designed with leach capacity of 58 hours. Further, the extra tankage is justified due to the need to have flexibility for tanks to go offline for maintenance and repairs. This will ensure an improved circuit reliability and availability and hence protect the required minimum residence time of 40 hours.

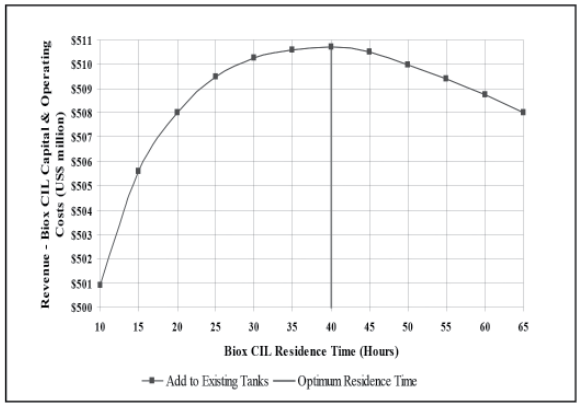

Figure 9. Impact of additional tanks on revenue (MacIntyre, 2005).

CONCLUSION

This study was set out to explore causes of leach recovery challenges in the ore being treated at Bogoso/Prestea Mine of Golden Star Resources, and concludes that the ore is double-refractory to conventional cyanidation. This conclusion is drawn after a combination of partial chemical analysis, diagnostic leach tests and optimisation leach tests. The flotation process produces concentrate of 15% pyrite, suitable for BIOX process.

The chemical analysis predicts that the BIOX reactions from the concentrate will be net acid consuming. Therefore, in an operation where reactor pH control is less than adequate, the tendency for pH increases and increased jarosite formation is high. Also, gypsum formation appears unavoidable due to the requirement for pH adjustment prior to cyanidation. These two minerals are major contributors to low leach performance.

Diagnostic leach tests showed that 48.34% of the leach residue (BIOX CIL Tails) is gold that is preg-robbed by carbonaceous matter and 17.12%, unliberated gold in silicates. Free gold, gold in sulphides and carbonates accounted for 13.4%, 11.51% and 9.65% respectively.

Cyanidation leach tests on the BIOX product was optimised at 90.4% gold recovery at 7 kg/t NaCN, 40-50 g/l activated carbon addition and a residence time of 40 hours. The leach performance is very sensitive to cyanide addition and availability of enough active carbon. Cyanide consumption increases with poor washing efficiency in the CCD circuit and vice versa.

The BIOX product recorded a preg-robbing index (PRI) of 72.7% and the flotation concentrate returned 64.4% PRI. This confirms the inability of the BIOX process to deactivate carbonaceous matter and emphasises the significance of the requirement for active carbon in the CIL process. The need to heighten investigations into reducing the preg-robbing activities of carbonaceous matter can therefore not be over emphasized.

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