
ENFORCEMENT OF COMPLIANCE REQUIREMENTS AT OMAI GOLD MINES LIMITED - GUYANA

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SUMMARY

The gold extraction operations of OMAI GOLD MINES LIMITED (OGML) are multi-million dollar open cast operations in the forested interior of tropical Guyana. The mining area is bounded on two sides by the OMAI RIVER and the ESSEQUIBO RIVER. Other mines carry out dredging operations for the same purpose on the ESSEQUIBO RIVER in the vicinity of the OGML concession and loggers fell and crude-dress timber at isolated small concessions in the neighbourhood.

The operations at OGML engage hundreds of live-in staff and utilize sodium cyanide to separate gold from ore impurities such as iron, copper, nickel, lead and zinc. These facts create environmental concerns which had to be addressed and which attracted the ire of neighbouring miners as well as the intervention of the Environment and Health Sections of the Guyana Government. At least one non-government organization (NGO) and two groups concerned with indigenous peoples' rights have expressed keen interest in the activities of OGML.

This paper seeks to examine the introduction of voluntary compliance and enforcement requirements into the extractive industrial realm of the Guyana environmental scenario, and to assess the success or failure of this introduction.

1 INTRODUCTION

Omai Gold Mines Limited (OGML) is a subsidiary of the Canadian mining company, CAMBIOR, which holds 60% of the common shares, along with another Canadian company Golden Star Resources Limited (35%) and the State of Guyana (5%). Construction and development operations at the mine site about 100 miles south of Georgetown started in September 1991 with a projected budget of US\$152 million. Mining activities commenced in February 1992 and by December 1992 probable mineable gold reserve were estimated at 2,268,000 ounces. The first gold bar was poured 1st February 1993 and is estimated that ore reserves are about 40.6 million tonnes (metric) at 1.63 g/t Au. Gold recovery is thus about 93.5%.

The extraction is expected to last 10-15 years and nearly one thousand persons will be employed.

The annual rainfall at the mining site is 2.6 m. and the natural vegetation is a typical humid tropical rain forest.

2 THE ENVIRONMENTAL PROBLEMS

2.1 Toxic chemicals

The use of sodium cyanide (NaCN) in the amalgamation process probably poses the greatest environmental threat. Cyanide is a very poisonous substance which may infiltrate water sources or escape into the air. Thus it may be inhaled by human beings, drunk if it gets into the potable water system, or may enter the food chain unobtrusively.

It is imported into the country in the form of pellets via a port about 65 miles up the Demerara River, then transported overland along the Mabura Hill Road (See Fig. 1) to the mining site. There it is stored and used as needed.

Use of cyanide at the mining site entails emptying the sealed plastic container into a huge hopper where it is mixed with water and the solution is then pumped to the thickener tank. There it mixes with the ore crushed to a pulp. The cyanide concentration of this slurry is about 0.4 g/L.

The cyanide is eventually freed of the particles of gold and removed from the reclaim water and neutralized at the tailings pond (Fig 2) at the end of the process.

2.2 Solid waste

The next most important environmental problem is the discharge of solid waste at the mine site. This waste is of two types: sewage and kitchen/office waste. The latter is incinerated on a regular basis while the former has been the subject of continuing debate and modifying strategies.

The present use of a Rotating Biological Contactor (RBC) System has proven inadequate and has resulted in complaints from neighbouring miners of contamination of the river water and the emanation of disturbing odours from the facility. A new system of anaerobic/aerobic lagoon treatment is being installed which should remove both threats.

3 COMPLIANCE AND ENFORCEMENT APPROACH

3.1 Absence of environmental legislation

There has been no legislation in Guyana for environmental control of mining operations. The Guyana Geology and Mines Commission (GGMC) under the MINES ACT of 1989, exercise close inspection of the operations at OMAI in so far as gold production and the integrity of the claim are concerned. The environmental standards observed by OGML are those set by the Quebec Province of Canada.

3.2 Environmental impact study

In 1988 OGML retained RESCAN ENVIRONMENT SERVICE INCORPORATED, of Vancouver, Canada, to conduct, an Environmental Impact and Socio Economic Study of the proposed operations at the OMAI site. The Environmental Impact Statement (EIS) was filed with the GGMC, January 1991, with an addendum to the statement filed in January 1992. The EIS provided an extensive survey of the mine site and recovery process for conditions of climate, vegetation, terrestrial wild life, riverain aquatic life, quality of surface water and hydrology, ground water hydrology, local archaeology, waste disposal and socio economic considerations.

3.3 Development of inspection and monitoring capacity

The GGMC is progressively improving its capabilities to monitor environmental aspects of mining in Guyana. However, since its establishment in 1988, the Guyana Agency for Health Sciences Education, Environment and Food Policy (GAHEF), has been tasked by law with monitoring all environmental impacts nation-wide, including those of the mining industry. Consequently it has established a sound working relationship with the GGMC in which the latter consults with GAHEF before granting licence to any large mining concession.

OGML has been complying with the requirements of this relationship. In fact, both the GGMC and GAHEF have peculiar requirements that the company (OGML) is expected to comply with. The Environmental Management Agreement for small and medium scale mining operations has in part requested that post-operation rehabilitation procedures be assured before a mining licence be

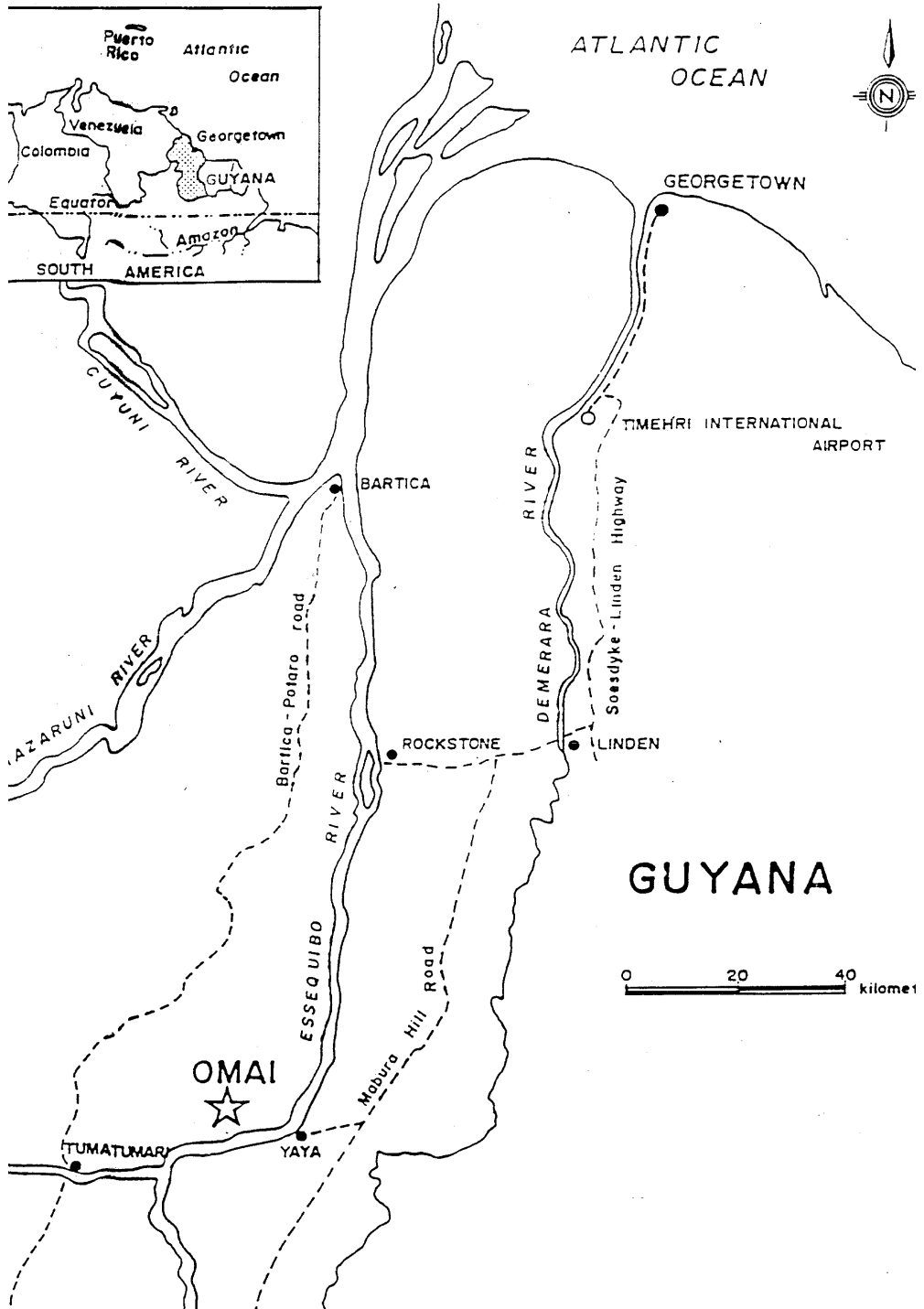


Figure 1.

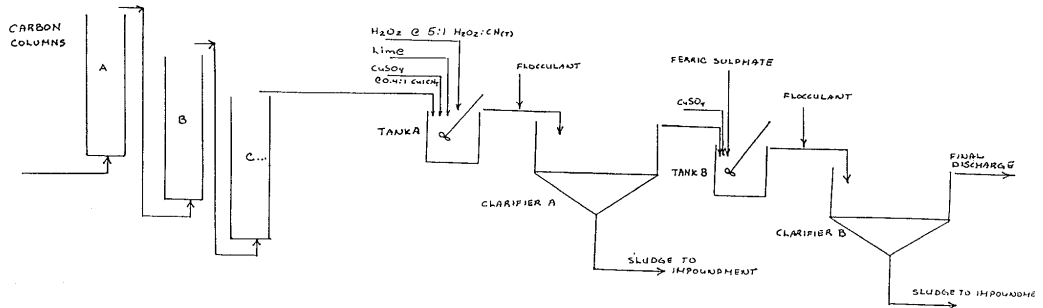


Figure 2. Omai effluent treatment conceptual flowsheet.

granted. This assurance is given by OGML in their EIS as they propose a comprehensive plan of rehabilitation of the entire site upon abandonment of the area at the end of the project.

Monitoring by GAHEF is centered mainly around the tailings impoundment, but all other aspects of the operations are considered, especially the health of the workers at the mine site. Water quality sampling, testing and analyzing are conducted on a regular basis (Table 1) and the results are forwarded to GAHEF as soon as they are available (Table 2). OGML has also agreed that GAHEF may run totally independent tests at any time.

All accidents or malfunctioning of equipment which could pose the slightest environmental threat are reported immediately to GAHEF and the GGMC so that immediate independent investigations could be mounted either jointly or separately by these bodies.

Periodic observations of wildlife behaviour in the area are made as well as bioassays of the various water courses or water bodies within and connected to the mine site area. These are expected to inform the sum total of the surface water quality impacts of the OMAI project.

3.4 Water quality monitoring results of Guyana's approach

Table 1 indicates the frequency with which water quality is monitored, the locations of sampling stations and the chemical parameters monitored at each station. Table 2 is a sample of the recorded results. Every month these results are submitted to GAHEF. Impromptu inspections of sampling operations are conducted by senior officials of the Environment Division of GAHEF and the new Environment Protection Agency is expected to intensify this activity and institute independent spot sampling at the location/mine site.

During 1993 the higher level of cyanide was detected in the Reclaim Pond. Values ranged from 102 mg/L in March to 19.30 mg/L in June (Fig. 3). The values recorded for CNWAD showed a gradual decrease ranging from 78.52 mg/L to 32.0 mg/L, and values for CNS were comparatively low ranging from 30.4 mg/L to 21.00 mg/L. These values will be greatly reduced before any release is made from this Reclaim Pond into the environment. It is envisaged that a two-year standing period will be adequate to neutralise the cyanide in this pond before the water is released into another holding pond and then, after testing, into the environment.

In the Aeration Pond the range of free cyanide is from 0.156 mg/L to mg/L, where the highest level is just beyond the Canadian (Quebec) limit observed by the OGML. The highest level of total cyanide in this Aeration Pond, 0.448 mg/L, is below the 1.50 mg/L accepted by the Quebecan standards. The trend during the year is a gradual reduction in cyanide concentration except in the Reclaim Pond in the later half of the year.

This may possibly be explained by the increased level of processing in that period. In the OMAI river upstream and downstream the total cyanide level remained below 0.002 mg/L throughout

Table 1. OMAI GOLD MINES LIMITED, Environmental H₂O Monitoring Program

Station/Sample Location	Weekly (Every Sunday)	Monthly (15th Day of Each Month)
1 Reclaim H ₂ O - Mill	X	X
2 Aeration Pond	X	X
3 Omai River - Clear H ₂ O Pond		X
4 Omai River - Upstream		X
5 Omai River - Downstream	X	X
6 Captain Mann - Creek		X
7 Essequibo River		X
8 Anaconda Well Water	X	
9 Gilt Creek Drainage		X

WATER SAMPLING PARAMETERS**Weekly**

1 Reclaim H ₂ O - Mill:	pH, TDS, TSS, Total CN ⁻ , Free CN ⁻ , Cu, Pb, Zn, Ni, Fe, Au, pond level.
2 Aeration Pond:	pH, TDS, TSS, Total CN ⁻ , Free CN ⁻ .
5 Omai River Downstream:	pH, TDS, TSS, Total CN ⁻ .
8 Anaconda Well Water:	pH, TDS, TSS, Cu Ph, Zn, Ni, Fe.

WATER SAMPLING PARAMETERS**Monthly**

1 Reclaim H ₂ O - Mill:	Temp, pH, TDS, TSS, Hardness, Total CN ⁻ , Free CN ⁻ , CNWAD, CNS ⁻ , NH ₃ N, SO ₄ ⁻ , NO ₃ ⁻ , Cu, Pb, Zn, Ni, Fe, Au, oil and grease.
2 Aeration Pond:	Temp, pH, TDS, TSS, Hardness, Total CN ⁻ , Free CN ⁻ , CNWAD, CNS ⁻ , NH ₃ N, SO ₄ ⁻ , NO ₃ ⁻ , Cu, Pb, Zn, Ni, Fe, oil and grease.
3 Omai River - Clear H ₂ O Pond:	Temp, pH, TDS, TSS, Total CN ⁻ , Cu, Pb, Zn, Ni, Fe, oil and grease.
4 Omai River - Upstream:	Temp, pH, TDS, TSS, Total CN ⁻ , Cu, Pb, Zn, Ni, Fe.
5 Omai River - Downstream:	Temp, pH, TDS, TSS, Total CN ⁻ , NH ₃ N, NO ₃ ⁻ , Cu, Pb, Zn, Ni, Fe, oil and grease.
6 Captain Mann - Creek:	pH, TDS, TSS, Total CN ⁻ , Cu, Pb, Zn, Ni, Fe, oil and grease.
7 Essequibo River:	pH, TDS, TSS, Total CN ⁻ , Cu, Pb, Zn, Ni, Fe, oil and grease.
9 Gilt Creek Drainage:	Temp, pH, TDS, TSS, Hardness, Total CN ⁻ , Free CN ⁻ , CNWAD, CNS ⁻ , NH ₃ N, SO ₄ ⁻ , NO ₃ ⁻ , Cu, Pb, Zn, Ni, Fe, oil and grease.

Table 2. OMAI GOLD MINES LIMITED, Environmental Water Monitoring (Sample Date: January 15, 1994)

Water Sampling Station Parameters	1	2	3	4	5	4	7	8	9
	Reclaim Water	Aeration Pond	Omai River	Omai River	Omai River	Captain Mann	Essequibo River	Anaconda Well Water	Gilt Creek
	Mill	Aeration Pond	Clear H ₂ O Pond	Up-stream	Down-stream	Creek	Comp intake H ₂ O	Comp Intake H ₂ O	Drain-age
pH	9.80	7.38	5.14	5.03	5.80	N/A	6.65		6.88
Temperature °C	20.8	20.8	24.6	26.0	24.0	N/A	27.7		20.2
Total suspended solids (mg/L)	16.4	34.0	2.0	2.0	1.2	N/A	5.2		0.8
Total dissolved solids (mg/L)	597	96.4	12.1	12.2	11.4	N/A	8.6		214
Conductivity (microS/Cm)									
Hardness mg/L as CaCO ₃	25.43	58.19							45.74
Oil and grease (mg/L)									
Disanions:									
Sulfate SO ₄ 2 (mg/L)	388.0	51.03							90.72
Nutrients: (mg/L)									
Ammonia as nitrogen NH ₃ -N	9.66	0.77			0.34				N/A
Nitrate NO ₃	3.19	6.29			2.17				46.96
Cyanides: (mg/L)									
Total Cn	24.3	0.007	<0.002	<.002	<.002	N/A	<.002		<.002
Free CN	10.92	<0.02							<0.02
CNWAD	22.00	<0.02							<0.02
CNS	28.0	2.0							1.6
CNO									
Dissolved Metals: (mg/L)									
Cu	6.142	<0.01	<0.01	<0.01	<0.01		<0.01		<0.01
Pb	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01		<0.01
Zn	0.990	0.011	0.015	0.012	0.013		0.100		0.024
Ni	0.195	0.015	0.008	0.005	0.011		0.005		0.019
Fe	0.526	0.101	0.442	0.383	0.524		0.163		0.057
Au	0.049								

Note:

Reclaim water pond level: 511.698 m above sea level.

N/A - indicates not available (dry creek).

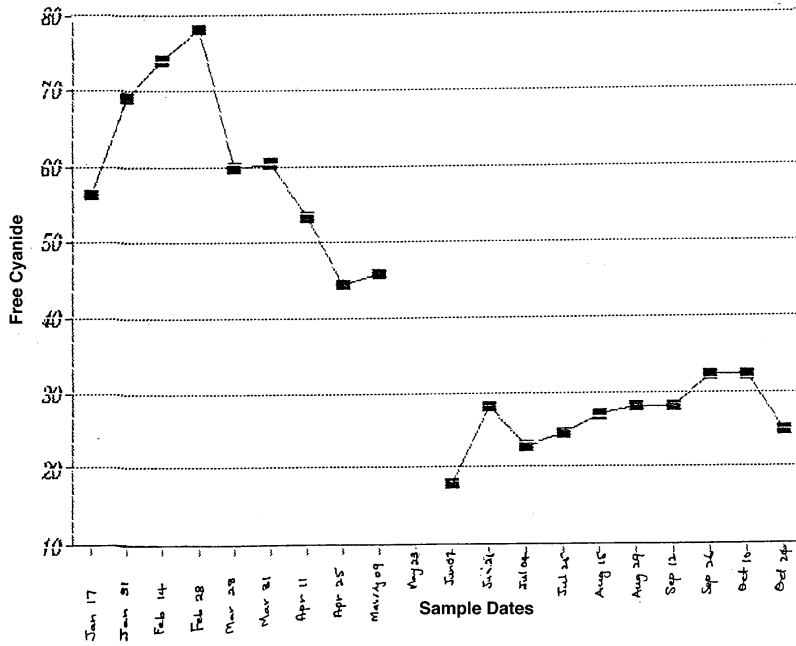


Figure 3. Reclaim water (free cyanide).

Table 3. OMAI GOLD MINES LIMITED, Final Effluent Quality Objectives

Free cyanide	0.10 mg/L
Total cyanide	1.5 mg/L
Copper	0.30 mg/L
Lead	0.20 mg/L
Zinc	0.50 mg/L
Nickel	0.50 mg/L
Iron	3.0 mg/L
pH range	6.5 to 9.5

the year except in October in the downstream where mg/L was recorded. The was still below the standard of 1.5 mg/L.

3.5 Resource costs of compliance monitoring

The cost of instituting such compliance measures as outlined above as well as those attendant on waste disposal at OGML is met by the company. The Environmental Protection Agency of the Government is slowly building the capacity to independently enforce compliance but as far as monitoring OGML is concerned the cost of surveillance has been minimal: confined to pay the salary

of the officers who visit the site, not on a regular basis. OGML spends over US\$150,000 annually to ensure that adverse environmental impacts of its operation are transparently mitigated.

It is anticipated that the cost of enforcement when the Agency is fully operational will be in the vicinity of US\$4,000 annually.

4 FACTORS CONTRIBUTING TO THE SUCCESS OF THE PROGRAM

The environmental protection programme of the OGML may be considered successful given the stage of development of the industry. The major factors which seem to have contributed to this success are:

- The existence of standards, in this case those set by the home country of the foreign company involved in the development.
- International pressure which is exerted by the various environmental lobbies worldwide.
- National public awareness, mainly championed by NGO's.
- National official policy portrayed by a government concerned with environmental protection.
- The existence of a compliance and enforcement body with the legal authority and adequate facility to set regulations and enforce compliance. The body in this case is fairly fledgling in that its capacity is not fully developed and the legal authority is more or less inadequate.
- Willingness on the part of the developer to observe standards set both nationally and internationally and cooperate with local enforcement agencies. The attitude of OGML is impeccable in this regard.

5 CONCLUSION

The progressive successful implementation of compliance strategies based on cooperation between the developer and the enforcement agency should be adopted in other areas with appropriate modifications where necessary. However, there must be a body of legislation against which enforcement activities are grounded. The Environmental Protection Bill as well as the Environmental Impact Assessment Bill which should be passed by the Guyana Parliament shortly will provide adequate clout for environmental compliance and enforcement strategies in Guyana. The Environmental Management Agreement developed by the GGMC in collaboration with GAHEF and the miners' Association, as well as other NGO'S, is another environmental protection tool which is part of the national strategy.