MITIGATION CAPACITY RECOVERY OF DAMPING IN GELADINHO DAM TROUGHT OUT THE SEDIMENTARY ADVANTAGE LIKE IRON ORE PRODUCT[1]

José Carlos de Oliveira[2]
Marcelo Bustamante de Almeida[3]
Francisco Rodrigues Patto[4]
Tatiana Martins Machado Brandão[5]
Raimundo Honório Queiroga Junior[6]
Ernesto Crivella[7]

Abstract
The Geladinho is a sedimentary contention dam of iron ore Carajás plant since 1995. Just right the quantitity of material released in this contention, restricting the capacity of damping and being necessary prevention exits. After studies, were analysed two conditions for the probleam solution: the increase of dam slope or dredging. Dredging was chosen because of the lower enviromental impact and less time for implantation, being realized by pumping material to Gelado dam. Looking for another use to the material, drilling confirmed a viable economic quality, resulting in another study: the ore recuperation, bringing benefits as such a production increase, enviromental impact reduction and operacional costs, alsome avoid the Gelado dam acumulation. For this, two fronts of work are adopted with a exploration using cutter suction dredger downstream and backhole upstream, resulting in an annual production in order of 1.250.000 tonnes of iron ore.
Key words: Recovery; Dam; Dredging; Damping.

[1] *Technical contribution to the 3rd International Meeting on Ironmaking, September 22 – 26, 2008, São Luís City – Maranhão State – Brazil*
[2] *Analista Operacional (VALE, Diretoria de Ferroso Norte, Gerência de Produção e Processo de Pellet Feed)*
[3] *Engenheiro Ambiental (Geoexplore Consultoria e Serviços)*
[4] *Gerente de área de Produção e Processo de Pellet Feed (Vale)*
[5] *Engenheira de Minas (Vale, Gerência de Produção e Processo de Pellet Feed)*
[6] *Gerente Geral da Usina de Tratamento de minério de Ferro de Carajás*
[7] *Consultor na área de dragagem*

1 INTRODUCTION

This paper presents a new alternative for the performance of mitigation capacity recovery of Geladinho dam. The advantage of this alternative is that with a single operation will be possible:
Remove the capacity of damping of Geladinho;
Save storage capacity in Gelado Dam;
Recovering material from Geladinho for marketing.

2 GELADINHO CURRENT SITUATION

Due the process of silting caused by flows of solids from various sources, the waste occupied all the region, until the dam. As a result, Geladinho lost the capacity of damping, which is the loss of hydraulic security and overflow risks, and even a dam colapse.
The analysis that studies the best alternative for restoring the capacity of damping shows up the possibility of increase dam slope in comparison with an alternative to restore the dam conditions by dredging.

3 HISTORY OF STUDIES

Here we will consider three alternatives for possible measures to recover the capacity of dam, whose technical caracteristics are summarized below:

3.1 Alternative I (Increase Dam Slope)

This alternative has many of technical, economic and environmental negative aspects that will be summarized below:

- The increase of dam slope would require a large amount of clayey soils from the marginal áreas, which results in enviroment demage due to deforestation and economic costs required;
- The increase of water level dam can overflow marginal áreas, with the same damage already mentioned in the previous item;
- The increase of hydraulic pressure at dam base would cause water loss by percolating throught foundations with reduce the safety factor for landfills stability.

3.2 Alternative II (Dredging from Geladinho to Gelado)

The recovery of dam capacity can be achieved through dredging the most superficial part of silting formed by sediments, so as to restore the original surface of dam.
This alternative avoid some technical, economic and enviromental probleams in comparison by the previous alternative. This process is adopted today with Carajás dredger.

3.3 Alternative III (Selective Dredging with Product Recovery)

In this case, the material that is being dredged from Geladinho should be transferred to reservoior to lose water.
This alternative would enable the recovery the capacity of damping, while the recovery ore, increasing the production to market.

Just as the alternative before this procedure avoids the technical, economic and enviromental problems.

4 ALTERNATIVE III CONCEPT PROJECT

4.1 Reason Adopted

With studies were estimated that the volume of sediment deposited in Geladinho dam is in order of 4,000,000, m³, and considering an in-situ density of 2.2 t / m³ we have around 13,200,000 tons of sediments.
These sediments are deposited throughout the pipeline, providing a 100% recovery the material will be add to the product of iron ore in a period of 5 years.

4.2 Subdivision of Silting up Areas

For this, two fronts of work are adopted, as shown in Figure 1 below:

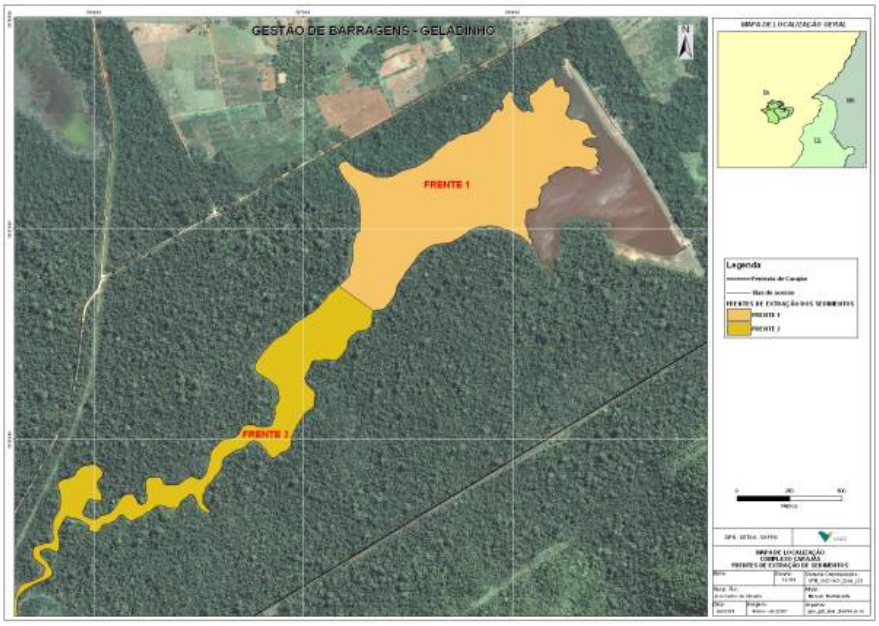

Figure 1 – Fronts of work for the material recuperation.

The first front of work will be performed by the Carajás dredger downstream to upstream, and the material should be transferred to a reservoior and then be transported to screen plant. It is estimated that the amount of ore in this front work it's in order of 9,240,000 tonnes.
The second front of work, will be implemented through mecanic cut and directly transported to screen plant. The amount of ore in this phase is estimated in around 3,960,000tonnes.
The summary table below shows the division in front of ploughing:

Tabela 1. Work Fronts

	Equipment	Volume (m3)	Mass (t)
Work Front 1	Dredge	4.200.000	9.240.000
Work Front 2	Backhole	1.800.000	3.960.000
		6.000.000	13.200.000

4.3 Work Front I – Sediments Extract with Carajás Dredge

Nowadays the Carajás dredge has been used to remove the Geladinho silt and this material has been launched in Gelado dam.
This project was designed to allow the Carajas dredger can pump the material for reservoior to dry and then be transported by truck to the screen plant. As shown in Figure 2, the tubing of dredger will be remain and installed an Y piece with two drawer valves to turn aside the mixture to Gelado ou reservoior. This reservoior are been builting at the site marked with an area of approximately 250m x 85m. The new tube to be installed will have approximately 1.500
m.

Figure 2 – Print for the new tube.

The material deposited in reservoior will be transported in trucks to the screen plant. The average distance of transport is around 4.5 km and the transport cycle is estimated at 40 minutes. To carry out this service, were scaled the following equipment: 2 wheel loaders and 5 trucks dumpers (25t).

4.4 Work Front 2 – Sediments Extract with Backhole

This work front will be run by backholes. The material removed will be deposited in the room for drying and then loaded into trucks to be transported to the screen plant.
To carry out this service, were scaled the following equipment:
3 backholes CAT-316
2 tractor
5 trucks (25t)

4.5 Investiments Value

For the system implantation in this alternative, it's estimated the following investment:

Table 2 Investiment Description

Item	Quantity	Number Amount (R$)
Accessories and tube repression	1.500 m	600.000,00
Fit up of tube repression	Vb	330.000,00
Valves	Vb	150.000,00
Software to control the dredger production	1	300.000,00
Dry reservoir construction	1	180.000,00
Topographical, geotechnical and hydraulic projects	Vb	100.000,00
Screen plant	1	1.900.000,00
Total		3.560.000,00

4.6 Operacional Direct Cost (Atual Dredging System)

The attual cost to remove the sediments of Geladinho Dam are bellow:

Table 3 Cost description og current dredging system.

Item	Qt	Unit	Unit Cost (R$)	Total Cost (R$)
Operation and maintenance of Carajás Dredge	9.240.000	ton	3,50	32.340.000,00
Oil for dredge	1	Vb		4.280.000,00
Wastage parts	1	Vb		3.000.000,00
Total in 4 years	9.240.000	t		39.620.000
Unit Cost R$ / Ton.				4,29

4.4.1 Direct cost operational (after introduce alternative III)

The direct operational cost is estimated at:

Tabela 4 Operational cost description with the deployed alternative.

Item	Qt.	Unit	Unit Cost/year (R$)	Total Cost (R$)
Operation and maintenance of Carajás dredger	9.240.000	t	3,50	31.500.000,00
Oil for Dredger		Vb		4.280.000,00
Wastage parts		vb		3.000.000,00
Shovel CAT-938	4	vb	845.000,00	16.900.000,00
Backhole CAT-316	3	Vb	580.000,00	8.700.000,00
Tractor CAT-D6	2	Vb	612.000,00	6.120.000,00
Truck 25t	10	Vb	462.000,00	23.100.000,00
Oil for equipments		vb		3.360.000,00
Screen plant operation		vb		1.850.000,00
Total in 4 years	13.200.000	t		99.530.000,00
Unit cost R$ / T				7,54

5 CONCLUSIONS

For this study we can obtain the following conclusions:
The first alternative (dam increase) in addition to all technical and economic problems, has a big cost for deployment almost $ 35.000.000,00.

- The second alternative (dredging from Geladinho to Gelado) is a good solution with a relatively low cost that is solving the emergency problem of Geladinho, but without adding values and damaging the capacity of Gelado.
- The thrid alternative (object of this study) is that we seem to be the most recommended, because with a single up work to recover the Geladinho, avoid load on the Gelado and with an increase in the cost of $ 3.26 / t regarding alternative II, generating a revenue, the recovery and sale of 13,200,000 tonnes of the product.

Acknowledgements

Ismar Ferrari consultant for helping in the development of this work;
The members of pellet feed production área for the development supporting and help on consolidation
Vale

REFERÊNCIAS

1 CRIVELLA, Ernesto: Relatório para a recuperação da capacidade de amortecimento de cheias na Barragem do Geladinho, 2007