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Development of an Integrated Management Strategy Model for Acid Mine Drainage Contaminated Areas Due Historical Coal Mining Activities in Santa Catarina Southern Brazil

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Abbrivations: SC: Santa Catarina; CTJL: Central Termoelétrica Jorge Lacerda; AMD: Acid Mining Drainage; CSN: Companhia Siderúrgica Nacional; IMS: Integrated Management Strategy

Introduction

The Coal basin of Santa Catarina (SC), includes an area over than 900.000 acres, in the southern region of SC, Brazil, involving 24 municipalitys, located between the towns of Araranguá and Lauro Müller. It contains a reserve of mineral coal around 4.3 billion tons, corresponding to 13% of the country total exploitation. The exploitation occurs mostly in 3 coal layers, economically viable, named: Barro Branco, Irapuá and Bonito, associated with Permian sedimentary successions of the Paraná Basin. The coal mining activities began in the early 1900s, and had a considerable expansion after the 2nd Word War. It remains locally important to the economical setting until to the present. The coal production was initially used to generated vapor in ships and as fuel suply to locomotives. After 1940 it started to be used primarily for steel industry. Since 1990, due the its high sulphur content and the opening of the local economy, most of the domestic coal production in Brazil has been used for power generation at Central Termoelétrica Jorge Lacerda (CTJL) in the City of Capivari de Baixo, SC. Meanwhile imported coal has been used for the country's steel making industry.

Until the earlies 1990s, before privatization, the Companhia Siderúrgica Nacional (CSN) owned over 70.000 acres of coal reserves, where it developed large subsuperficial (until 150 meters bg) and superficial mining activities, processing units, wastes landfills, transportation and other diverse coal mining related activities. During this period, the Barro Branco and Irapuá formations were exploited, and due the metalurgical characteristics, the coal was extensivelly enployed in the first integrated steelmaker in Brazil, placed in the City of Volta Redonda, Rio de Janeiro State. From 1991 to 2000, CSN has began a closure mining program in the entire region, were the main assets were selled to third parts. As a result of these operations, more than 1.210 acres of superficial areas and 2.400 acres of subsuperficial mined areas, divided in 33 units, 46 mining entrances, in 7 diferent municipalitys, were officially recognized as contaminated land over legal responsability of the CSN, mainly located in third parts proprieties. Beside CSN other 17 mining companys had operated in these regions during the same period, contributing to the generation of Acid Mining Drainage (AMD). In total, these operations resulted in more than 6.000 acres of superficial mined areas and 16.000 acres of subsuperficial mined areas, 820 abandoned mining entrances identified to the present, that resulted in several regional impacts to the environment.

Study objectives

The main objective of this project is the development of an Integrated Management Strategy (IMS) model for AMD contaminated areas under legal responsability of CSN, due historical coal mining activities in Santa Catarina. Due to factors such as the large extensions, geological and stakeholder complexities, several of the areas can be classified as complex sites. Tipically, at complex sites, remediation progress is uncertain and remediation is not anticipated to achieve closure or even long-term management within a reasonable time frame. Both technical and nontechnical challenges can limit remediation.

Methodology

Both technical and nontechnical challenges for AMD contaminated areas are, in several situations, similar to the definitions used by the ITRC [1,2] guidance for classification of complex sites". At some complex sites, site-specific conditions make it difficult to fully remediate environmental contamination. Both technical and nontechnical challenges can impede remediation and may prevent a site from achieving federal- and state-mandated regulatory cleanup goals within a reasonable time frame. According to ITRC, technical challenges may include geologic, hydrogeologic, geochemical, and contaminant-related conditions as well as large-scale or surface conditions. In addition, nontechnical challenges may also play a role such as managing changes that occur over long time frames, overlapping regulatory and financial responsibilities between agencies, setting achievable site objectives, maintaining effective institutional controls, redevelopment and changes in land use, and funding considerations.

Considering these challenges, it is necessary to employ a concept that have being recomended to manage complex contaminated areas, described by ITRC as "adaptive site management". This process is comprehensive, flexible, and iterative; it is well suited for sites where there is significant uncertainty in remedy performance predictions. Adaptive site management includes setting short-term interim objectives and long-term site objectives that reflect both technical and nontechnical challenges. The remedial approach may involve multiple technologies at any one time and changes in technologies over time. Comprehensive planning and scheduled evaluations of remedy performance help decision makers track remedy progress and adjust the remedy, if needed, to stay on track to achieving short-term interim objectives. Long-term planning can also improve the timeliness of remedy optimization, reevaluations, or transitions to other technologies or contingency actions. From this concept, the main initial tasks addopted for the development of a Integrated Management Strategy Model for Acid Mine Drainage Contaminated Areas due historical coal mining activities in Santa Catarina were:

1. Revision and organization of available data regarding previous environmental studies performed at the site
2. Presentation and short description of successful cases of environmental management in sites with similar issues that adopted criteria to prioritize areas for soil and groundwater remediation
3. Site visits
4. Identification of data gaps regarding the site conceptual models
5. Classification of the site regarding complexity aspects and site conceptual models developments
6. Elaboration of investigation plans for the different areas of concern, ranked according to urgency
7. Consolidation of a strategic, long term plan
8. Continuos dialogues with key stakeholders

Results and Conclusions

An Integrated Strategy Management (IMS) model for AMD contaminated areas under legal responsability of CSN has evolved and evaluted. A result of this proposition is the reconigtion that the most advanced global pratice for environment management of mined areas have similaties with strategies employed for management of contaminated areas. This approach is focused on the development of robust conceptual site models and quantification of ecological and human health risks that leads the proposition of intervention plans, with objective to recovery the natural environment at mining degradated areas. It was also reconized that the adaptive site management concept is well suited for AMD contaminated areas that reach the objectives of the intervention plan.

Aknowledgement

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