From Rio 92 to Rio+20

CETEM and sustainable research on mineral resources

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From Rio 92 to Rio+20: CETEM and Sustainable Research on Mineral Resources

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CETEM

Rio de Janeiro
June 2012

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From Rio 92 to Rio+20: CETEM and the Research on Sustainability of Mineral Resources/ Francisco Rego Chaves Fernandes, Fernando Antonio Freitas Lins, Roberto C. Villas-Bôas (Eds.). - Rio de Janeiro: CETEM/MCTI, 2012.

70p.: il.

1. Sustainability. 2. Mineral Resources. 3. Rio+20. I. Mineral Technology Center. II. Francisco Rego Chaves Fernandes (Ed.). III. Fernando Antonio Freitas Lins (Ed.). IV. Roberto C. Villas-Bôas (Ed.).

ISBN 978-85-61121-90-7 CDD - 622.7

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Presentation

Today's Brazil that hosts the United Nations Conference on Sustainable Development, Rio+20, is quite different from the country that hosted the United Nations Conference on Environment and Human Development, known as Rio92, 20 years ago. Within the two conferences, especially over the last ten years, the country has consolidated its democracy and become one of the world's largest economies.

However, we still have a long way ahead of us. The new world economic order is based on knowledge as a way to generate innovation. To meet this challenge, it is necessary to clearly define public policies capable of ensuring social, environmental and economic sustainability. Fostering innovation and strengthening of scientific and technological base are needed to achieve a green economy.

The Ministry of Science, Technology and Innovation makes it available to society the National Strategy for Science, Technology and Innovation, which covers the period from 2012 to 2015. The document consolidates actions and programs to meet five challenges:

1) Reduction of the scientific and technological gap that still separates Brazil from more developed nations;

2) Expansion and consolidation of the Brazilian leadership in the nature knowledge economy;

3) Expansion of the basis for environmental sustainability and the development of a low-carbon economy;

4) Consolidation of Brazil's new pattern of international insertion;

5) Overcoming poverty and reducing social and regional inequalities.

To meet these challenges, the government has set policy instruments of science, technology and innovation.

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Institutes for scientific and technological research, social interest organizations, fostering agencies, public companies that comprise the MSTI system, work in the various areas of knowledge and are geographically spread through several units of the federation. They work in partnership with interested segments of society and the corporate world and intend to expand these collaborations. One way is to publicize their work and show how their projects are important to the country's social and economic development.

This book shows how this interaction with society can be made possible. It reports the actions of the Mineral Center for Technology – CETEM over these 20 years that separate Rio92 from Rio+20. It is an example of the alignment of research institutes with MSTI's basic guidelines, according to the characteristics of each area.

With this initiative, CETEM offers its contribution to the objectives of Rio+20 and shows how to do the intermediation of state policies with the practical implementation of scientific knowledge, taking into account the needs of the Brazilian society.

Marco Antonio Raupp
Minister of State for Science, Technology and Innovation

Preface

This publication details the goals and outcomes of the major projects which have been developed at CETEM for the past 20 years in line with mining's sustainable development within the Rio 92 and Rio+20 conferences. It describes from global-scale pioneering works about mercury in the environment to the most sophisticated, cutting-edge mining-metallurgical processes, going through a considerable range of the "social technologies" developed.

As highlights in the coming article, I point out CETEM'S first activities on sustainability one year before Rio 92 and already in full observance of the Brazilian Citizen Constitution, with the Program for Environmental Development and the Poconé Project (Mato Grosso State), focused on mercury, gold and the miner. Within this same line of research, it also addresses the Global Mercury international program, 2002, reaching the Amazon and Indonesia.

The article presents two case studies of human contamination resulting from the mining activity, one in Bahia and another in Rio de Janeiro, approaching the territoriality of the mining municipalities by assessing the advantages and disadvantages of the activity for communities in more than twenty case studies on Large Mines and Clusters, pre-announcing some assumptions of the future social mining license.

It is also detailed in the referred article more than two dozen projects currently ongoing at CETEM on waste from mining (remediation, reuse and recycling), a very contemporary approach. Originating from urban disposal of mass electronic goods and materials from demolition and the civil construction, which require Urban Mining to be reused, as well as those wastes that are generated from several tens of thousands of mining-metallurgical enterprises, located throughout the country.

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The book also summarizes about 160 works and publications by CETEM, classified by sustainability, indicators, social technology, environment, residues and recycling.

Fernando A. Freitas Lins
Director of CETEM

From Rio 92 to RIO+20: CETEM and the Sustainable Research on Mineral Resources

Introduction

In the last century it was believed by both the majority of the population and the governments that the environment was an inexhaustible source of natural resources. However, environmental problems started getting worse and it was necessary to review those practices. From then on, the environment began to get more attention from scientific and academic communities, from the media, and more generally from society.

Such attention culminated in the execution of a series of very important international events in order to debate the issue.

In June 2012, the United Nations Conference on Sustainable Development takes place in Brazil, better known as Rio+20. It has been twenty years since the UN Conference on Environment and Development (Rio 92) and ten years since the '2002 World Summit on Sustainable Development '- WSSD (or Rio+10) held in Johannesburg.

All these initiatives have in common the discussion, implementation and recognition of the concept of Sustainable Development.

This paper will be showing a historical overview of how this issue started (1989) at the Center for Mineral Technology - CETEM and its incorporation to the main lines of research (1989-2012).

CETEM

CETEM is a research institute under the Ministry of Science, Technology and Innovation – MCTI, which, since it started operating in 1978, has been devoted to technological development in areas related to mineral technology. The Center was linked to

the Ministry of Mines and Energy and the National Department for Mineral Production, and subject to the Company of Mineral Resources Research.

In January 1989, CETEM became one of the units of the National Council for Scientific and Technological Development (CNPq) of the Ministry of Science, Technology and Innovation and, in 2000, within the MSTI, CETEM migrated from CNPq to MCTI. Nowadays, it integrates the Under Secretary of Research Units Coordination.

Throughout 34 years of activity, the Center has achieved national and international prestige through its contributions to the development of the country's mining-metallurgical industry with the firm intention to settle its mission and research activities aligned with the principles of Sustainable Development.

The Fundamentals of Sustainable Development

The discussion about the use of natural resources by society is held in the economic thought since the very beginning. Some of the theories that initiated economic science also focused on the environment and date back to 1798 with the publication of 'An Essay on the Principle of Population', by economist Thomas Malthus. In this book, the author developed a theory about the unequal nature of food supply and population growth. Population growth was subject to exponential growth, whereas food supply was subject to a linear growth model. That is, world population would keep on growing while food supply could not keep up with such growth.

Meanwhile, in 1817, economist David Ricardo's 'Law of Diminishing Returns' also warned off the limits of natural resources. According to his theory, more and more producers would increase their working time and efforts to obtain the same output, as the earth's fertility would gradually decrease.

Thus, the distinction between renewable and non-renewable resources was then set and this concept remains until today.

The first concerns about the large amount of materials that are not reused by society and then turn into an environmental problem and their consequences were formally recognized at the Club of Rome meeting in 1968, and a study, led by Dennis Meadows, was thus requested. The report, entitled 'The Limits to Growth', was published in 1972 and became known as 'Zero Growth', because it preached the need to halt the global economic growth in view of the virtual depletion of natural resources in the future, which would lead to the collapse of civilization.

Major world forums

In 1972, the UN Conference on the Environment, also known as the Stockholm Conference, brought together industrialized and developing countries to discuss how to reconcile the environment and quality of life. The discussions were attended by 113 countries and 400 governmental and non-governmental organizations. Two groups empowered the discussions: the developed countries, which advocated 'zero development', and the less developed nations, which defended 'development at any cost'.

As a result, the final decisions in the Declaration on the Human Environment introduced in the international political agenda the environmental dimension as conditioning and limiting to the traditional model of economic growth and use of natural resources.

Some years later, in 1983, the United Nations created the World Commission on Environment and Development.

In 1987, the Brundtland Report (Our Common Future) was released, one of the first global efforts to compose an agenda for a paradigm shift in the model of human development. The work of this Commission has influenced scientific studies on the depletion of the ozone layer, climate change and the impacts of energy use in the environment. It originated the concept of Sustainable Development as: "Sustainable Development is one that meets present needs without compromising the ability of future generations to meet their own needs."

Twenty years later the international community met again to discuss the issue in the United Nations Conference on Environment and Development (UNCED), better known as ECO 92, Rio 92, or Earth Summit, in Rio de Janeiro, 1992. The meeting's main objective was to seek ways to reconcile economic and social development with the conservation and protection of the Earth's ecosystems.

The specific commitments adopted by the Rio 92 Conference include two conventions: on Climate Change and on Biodiversity, besides A Statement on Forests. The Conference approved, as well, documents with broader goals and of a more political nature: the Rio Declaration and Agenda 21.

Agenda 21 can be defined as a planning tool for building sustainable societies in different geographic bases, which combines methods of environmental protection, social justice and economic efficiency. Thus, after Rio 92 it was agreed that all countries would produce their National Agenda 21. The process of preparing the Brazilian Agenda 21 was coordinated by the Commission for Sustainable Development Policies from 1997 to 2002 and involved almost 40,000 people from all over Brazil. One of the goals outlined in this document was the promotion of the Local Agenda 21 and the Integrated and Sustainable Development (goal No. 13).

The Conference was devoted once and for all to the concept of sustainable development and contributed to broader awareness that the damage to the environment was largely a responsibility of developed countries. It was recognized, at the same time, the need for developing countries to receive financial and technological support to advance towards sustainable development. However, the commitments made at the conference have been criticized by environmentalists, NGOs, experts and such, due to the weak interaction between the environment and development related to population issues and rising levels of poverty in various parts of the world, not to mention the lack of implementation of the decisions taken at that time.

Preparations for the next meeting of the World Summit on Environment in Johannesburg led to several actions in the context of mining and, eventually, their inclusion in this theme, especially in light of some environmental disasters that occurred in the period. In 2000, the global mining industry itself, concerned with society's perception about the synergisms between mining activities and the environment, proposed a joint action, funded by 28 major mining companies participating in the World Business Council for Sustainable Development – WBCSD, bringing together various segments of society, public and private institutions, trade unions, research centers, universities, indigenous communities, NGOs, among others.

The agenda included discussions on the topics of renewable energy, enterprises' environmental responsibility and promotion of Sustainable Development.

RIO+10 has made progress, such as advances concerning the means used to punish companies that pollute the environment and the establishment of mechanisms to have countries share the profits from international exploitation of their resources.

CETEM and the proposal for sustainability

The Federal Constitution of 1988, or the 'Citizen Constitution', was the first to mention the environment, opening up spaces for people's participation in the environmental conservation and protection, imposing as a duty environmental defense and posing environmental protection as a fundamental right of all Brazilian citizens.

With the democratization process in the whole country, a set of demands and environment-oriented requirements started being incorporated into CETEM for the first time and in a very clear way. Thus, even before Rio 92, the principles of sustainable development and social issues within the agenda were already part of CETEM's concerns.

Program for Environmental Technology Development and the Poconé Project

In 1991, CETEM was approved by the Congress to carry out a large Environmental Technology Program that culminated in the execution of the "Mercury Project – Poconé", a pilot project of national stature. The project dealt with economic and environmental issues of Brazilian gold mines and miners in a pioneer study in Brazil for being the first to be concerned about the issue of mercury in gold mining from a global point of view according to the technological, environmental, social, economic and sustainability pillars. The survey was also conducted in a pioneering partnership with several universities and national and foreign research centers, in environmental, social and health areas, providing a multidisciplinary approach to the study.

Project results on indigenous areas, the environment and their interrelationships with the mining activity were reported at Rio 92 along with other institutions, such as the National Museum, the Fluminense Federal University - UFF, the Federal University of Rio de Janeiro - UFRJ and the Federal University of Mato Grosso – UFMT.

Global Mercury Project

CETEM also took part in an international competition to carry out research projects under scope of the 'Global Mercury Project - Removal of Barriers to the Introduction of Cleaner Artisanal Gold Mining and Extraction Technologies'.

The Project started in 2002 and involved many countries, including Brazil and Indonesia, and intended to evaluate environmental contamination by mercury resultant of artisanal gold mining, that is suggested to be the potential source of international waters contamination. The project has been financed by international organizations: Global Environment Facility – GEF, United Nations Development Program and United Nations Industrial Development Organization – UNIDO.

An integrated approach was applied on the description of mercury distribution and environmental behavior and its adverse human health effects, allowing the understanding of negative impacts caused by environmental emission and human exposure. Yet, the involvement of gold seekers' organizations in both countries during the conception and execution of the projects provided new approaches and the continuity of the foreseen actions.

In Brazil, CETEM and IEC (Evandro Chagas Institute) accomplished the environmental and health evaluation in two gold mining areas at the Brazilian Amazon: São Chico and Creporizinho. 23 researchers (eight from CETEM and 15 from IEC) started field campaigns in Itaituba (Pará State) aiming at soil sampling, sediments and biota, in addition to describing the productive process steps and carrying out the technological characterization of the environmental samples.

At the same time, in Indonesia, CETEM and MFI - the Medical Forensic Institute of the Munich University (Germany) carried out the environmental and health evaluation in two gold mining areas on North Sulawesi (Talawaan) and Central Kalimantan (Galangan). The research group was composed by 11 researchers (7 from CETEM and 4 from MFI) and initiated the work in October 2003.

Campaign for clarification about mercury effects to human health

In Brazil, after carrying out the environmental and health evaluation, CETEM coordinated an informational campaign about Mercury effects to human health, that counted on attendance of countless governmental and non-governmental institutions and produced recreational learning materials with didactic information oriented to gold miners, aside from a number of training courses to municipal agents and gold miners, held in Itaituba (Pará State).

Case studies of severe human contamination: Santo Amaro da Purificação (Bahia State) and Queimados (Rio de Janeiro State)

Mineral substances are usually classified as non-renewable resources. Nevertheless, it is considered more appropriate to classify natural resources into sustainable and non-sustainable, in order to better implement the necessary public policies to the use of mineral assets, either renewable or non-renewable.

In regard to natural resources, it is necessary to highlight that in Brazil the mining activity is part of the country's settlement and history. However, the intensive and predatory prospecting, mainly beyond 1970's, caused many adverse impacts that lasted for a long time making it necessary to do an extensive work, based on the sustainability concepts and policies defined on the Agenda 21 of Rio 92 and widened at the Johannesburg Conference. Their impacts and the competition for land settlement and use have been causing serious social and environmental conflicts.

This situation is expressed on the large amount of abandoned residues that, when exposed to weather conditions, become a source of contaminants to the environment and to the neighboring communities. Some ongoing researches at CETEM focus on the mining activities' demand of social and environmental sustainability, searching for viable economic strategies to solve environmental liabilities. In this case, ongoing researches about waste contamination by lead processing in Santo Amaro (Bahia State) and illegal storage of mining residues in Queimados (Rio de Janeiro State) are enhanced.

In Santo Amaro (Bahia State), the slag deposited by a company that used to be part of a mining-metallurgical complex for lead alloys production contaminated the soil and the groundwater with heavy metals and CETEM is looking for actions to mitigate this great environmental liability.

In Queimados (Rio de Janeiro State), the population deals with the consequences of inappropriate activities of a residues treatment center that operated between 1987 and 1998. The residues coming from large mining companies and also from other

industries have remained storaged in the area and contributed to soil and groundwater contamination by heavy metals.

CETEM supports studies and research in the region in order to dimension the contamination impacts in the area and suggest alternatives to remedy the situation.

Positive change on the residues regulatory mark

Brazil recently changed the residues regulatory mark, contemplating mining residues. The former environmental system passed to the city council, i.e., to the entire society, the management responsibility. The new regimen contemplates the polluter pays' principle, in which the economic activity is responsible for its own residues. This current change is from 2010, Law No. 12,305 of Solid Wastes.

The importance of urban mining and recycling of residues generated by mining-metallurgical ventures

CETEM perceived the need of researching different scientific-technological approaches to recycling residues. They can be generated next to the ventures sites of different mining and metallurgical activities during the metal goods production chain, or belong to a large group of rejects generated by the mineral (non-metallic) industrial production, scattered on thousands of mining operations, placed everywhere. Another aspect is urban waste generation due to construction and demolition activities and to technological waste.

On the subject of unused metal mining, several projects have been developed, including the recovery of secondary metals (galena, sphalerite, chalcopyrite, etc.) on large companies' gold mining, besides the reuse of minerals present on residues of a copper mine, and also the recovery of metal values contained on zinc residues. It is also observed that low-content ores have been accumulating due to the exhausting of high-content deposits.

A more economical productive process that reuses low-content metals becomes necessary.

During the production of dozens of non-metallic goods, many residues are disposed of by productive enterprises, presenting risk to the environment and human health. CETEM conducted projects aiming to obtain artificial sand from fine gravel in quarries; scrap from civil construction to build a market of recycled aggregates; application of ornamental rocks' residues generated both during its extraction and processing, polymeric composites, asphalt paving, cosmetics and soil conditioners; reuse of ceramic residues and use of quartzite waste that can be added on glass and cement manufacturing.

It must be taken into consideration that the recycling of mineral goods present on the final products of mass consumption, mainly equipment and sophisticated electronic devices that become quickly obsolete, is concentrated on urban centers, where the vast majority of the Brazilian population is located nowadays. The concern about recovery and recycling brings to light the importance of Urban Mining. Following the line of urban waste reuse, we have the extraction of metals of the platinum group from automotive catalysts exhausts and the extraction of base metals and precious metals from electronic scrap through studies of electric leaching and bioleaching. There were also researches focused on aluminum food packaging recycling through a biotechnological route of aluminum extraction and recovery.

The bioleaching method is presented within this line as an innovative alternative on energy and raw material savings and on absence of fumes, for it presents as a starting point the recovery of metals in their metallic forms for further commercialization and use on the industrial sector. Yet related to recycling, CETEM has developed the eco-design project to analyze the quality of metals recycling, with emphasis on automotive steel and aluminum.

The Center also works on remediation through mitigatory immobilization, aiming to stop the negative and harmful impacts from coal mining. In the State of Santa Catarina, it was developed

a residue treatment providing the removal of heavy metals from coal mining wastewater. In the South region, it was realized the application of coal ashes from thermoelectric plants on the removal of heavy metals from mining wastewater. Still related to the subject, it is possible to mention the selective agglomeration of coal fines, the treatment of wastewater though lamella thickener, the development of a technology to control acid mine drainage, as well as the management of solid residues that cause acid mine drainage using dry covers.

By understanding sustainability as an articulation of social, environmental and economic policies that make feasible the quality of life of today's and future societies, it is fundamental to find agreements to allow or deny mineral prospecting in a certain region. The coexistence of mining and other soil uses depends on the territorial planning where society's priorities and necessities are foreseen.

Corporate social responsibility and social license

As a result of the discussions on sustainability, society started to follow and question about the social responsibility of mining companies. In this context questions have arisen about the benefits and harms that the mining activity brings to its surroundings, i.e., questions about corporate social responsibility and governmental actions (City, State and Union) in the communities.

With the advent of globalization, a mining group's activities increasingly depend on meeting legal obligations, i.e., that they are complying with legal norms often linked to environmental issues that, in most cases, exceed the mine boundaries.

There is a very wide range of social issues along the supply chain of the mining industry and in its relations with the local production site, causing the need for a triple license: mining title, environmental license and social license. The latter permit must be constructed through processes of consultation, participation and a solid dialogue among business-government-community.

Gradually, this theme has been incorporated into the projects developed by CETEM. Examples of this initiative are shown in the project 'Large Mines and mineral-based Clusters x Local Community', initiated in 2010 and sponsored by the Department of Geology, Mining and Mineral Processing of the Ministry of Mines and Energy (MME). The main objective was to highlight if the major mining companies and Clusters installed and in operation in Brazil, generated sustainable benefits to the communities where their mines are located.

As a result, 21 case studies were performed (14 great mines and 7 Clusters) and as a side result, it was consolidated the creation of the 'Mineral Resources Database and Community: Human, Social, Environmental and Economical Impacts', which is the compilation of a series of records - available in the academic, scientific and journalistic media - related to mining in the country. This database allows to highlight impacts of different origins caused by the mining activity, where several of them are directly connected with the issue of solid residues and environmental liabilities. Also, a multidisciplinary research thematic network was formed from the pooling of expertise from different institutions (universities and research centers) with an academic profile in the areas of mineral resources, sustainable development, regional development and large enterprises, environment, local community and related.

Small and medium-sized mining companies, the Clusters

CETEM also works with small and medium-sized mining companies due to the governmental demand to support Clusters. Projects to create new technological alternatives for the production of ornamental rocks that mainly seek to minimize the negative impact and increase productivity have gained importance.

The Center's interventions on this issue occurred in many States, such as:

a) on the project 'Ornamental Rocks in Santo Antonio de Padua – Rio de Janeiro', CETEM carried out treatment of wastewater

generated by sawmills of Santo Antonio de Padua for water and rock fines recovery to avoid silting of the region's rivers and streams. The study developed was able to recover 95% of used water and provided its reuse at sawmills. In addition, through an association with the National Institute of Technology, CETEM studied an industrial application to rock fines. Findings showed favorable uses of this waste in the production of cement and ceramic products (bricks and roof tiles). After the study, a cement factory was established in the place and produces nowadays 450T/day of the product.

b) on the project 'Technological adjustments for soapstone art in Mata dos Palmitos – Minas Gerais State', it is highlighted CETEM's performance front to federal institutions and universities to develop clean technologies for minimizing manufacturing impacts. The rural community of Mata dos Palmitos, Ouro Preto, (Minas Gerais State) has used soapstone on their art crafts for nearly one century. The activity was performed in a rudimentary way and caused large amounts of mineral dust emission, putting in risk workers' health and causing a great environmental impact. CETEM developed equipment that minimizes this dust emission besides creating a place for artisan training, considered reference to the introduction of Clean Technologies.

c) still on the Cluster theme, CETEM associated with SEDET - State Department of Economic and Technological Development, SEBRAE - Support Service for the Micro and Small Businesses, FINEP - Studies and Projects Sponsoring, and other institutions, and created the project 'Opala's Local Productive Arrangement', in 2005, to solve the conflicts between farmers and business people in the region of Pedro II, 200km from Teresina (Piauí State).

The issue of gender

One can say that the conception of research projects integrating with one of the pillars, the issue of gender, is still incipient at CETEM, but it had a mark on the Center with the accomplishment

of the Conference Cycle '"The issue of gender and child labor in South American small-scale mining", under the project financed by CNPq/PROSUL – South American Program to Support Cooperation Activities in Science, Technology and Innovation from the Department of International Cooperation/Multilateral Programs of the Brazilian Ministry of Science, Technology and Innovation. The main goal was to build a space for reflection, discussion and research about gender and child labor in activities of small mining in Argentina, Bolivia, Peru and Brazil. The most important information was put together on a pioneering book that, instead of exhausting the subject, invites everyone to reflect upon the themes and offers in an organized way, the information gathered and the reflections generated on the conferences and field work.

The Xingu-Tapajós aquatic ecoregion

Finally, CETEM's greatest experience in multidisciplinary works performed in the Brazilian Amazon and the Center's capacity in articulating institutional support were the main factors to a successful proposition for the coordination of a group effort of more than ten national scientific institutions, with the overall objective of creating a scientific, multidisciplinary and multi-institutional research network.

More than 40 researchers and technicians joined, besides hundreds of people who supported the project activities, generating primary data to the conservation and sustainable use of the region's natural resources. The multidisciplinary nature of the study reflects on the content that covers subjects as diverse as the region's economy and its aquatic organisms' biogeography. The main results of the study were presented in a book with the concept of aquatic ecoregion.

Technological Innovation

In regards to technological innovation, the Center reunites efforts for energy reduction and savings on mining-metallurgical processes, from the development of more sustainable technological routes. Through the project AGROMIN, the Center developed researches to use industrial minerals based on samples of zeolites collected in the States of Maranhão (MA) and Tocantins (TO). The mineral products modified in laboratory gradually release nutrients to the plants improving soil fertility and water retention.

On the same topic, the project 'Technological Characterization of the Ore from Angico dos Dias/Caracol (States of Bahia and Piauí): Seeking to Use Phosphate and Rare Earths', had the main goal to develop a process of dry concentration to the phosphate–apatite ore, given the shortage of water in the region. It was also studied alternative paths of acid leaching to obtain phosphoric acid in order to recover byproducts and minimize the environmental impact, as well as new ways to reuse water during the process.

The efforts on energy reduction and savings are also applied in another project, whose goal is to simulate and scale high-pressure roll presses aiming to apply on the grinding of rocks for crops.

Environment-focused technological innovation is developed in the project of desulphurization of residues from Criciúma (Santa Catarina State) from the remediation of wastes with sulphur in the form of pyrite. The process's main goal is to largely reduce the content of sulphur, so the waste can be disposed of without causing environmental impact, i.e., without generating acid drainage.

Current scenario

The United Nations Conference on Sustainable Development, Rio+20, will be held from June 13th to June 22nd, 2012, in the city of Rio de Janeiro. Rio+20 should help to define the agenda for Sustainable Development for the coming decades.

The document 'The future we want', also known as Zero Draft of the UN Conference on Sustainable Development presents the

positions of the Organization for the topics to be addressed in the Rio+20 Conference. The Conference will have two main themes: (i) green economy in the context of sustainable development and poverty eradication, and (ii) the institutional framework for sustainable development.

The theme 'green economy' challenges to think of a new model of development that is environmentally responsible, socially fair and economically viable, becoming a tool for Sustainable Development.

The theme 'institutional structure' is part of the discussion about the need for strengthening multilateralism as a legitimate instrument for solving global problems, increasing consistency in the performance of international institutions related to social, environmental and economic development.

Although the event has a plan of action to build a sustainable world, compatible with population growth, there is still no consensus to balance growth-sustainability. With the upcoming event, questions arise from the lack of focus of the discussions planned for the Conference and the lack of tools that would oblige countries to implement the decisions made there.

To the Minister of Environment one of the challenges is to promote society's engagement differently from what happened 20 years ago, through the implementation of goals for the design of cleaner policies for Sustainable Development. The Minister of External Relations reinforced that Rio+20 is not only about the environment and that the concept of sustainable development is still associated with the environmental discourse, though it must be understood in economic and social terms, as well.

Corroborating with the ministers, President Dilma Rousseff also argued that the Rio+20 Conference is not only about the environment, but also about green economy, poverty eradication and international governance for Sustainable Development. She repeated several times the motto "grow, include, protect and preserve" and summarized that the new mission is to propose a new paradigm of growth.

The ideas presented above are the basis of CETEM's vision of the present and future and whose intention is to continue being a Brazilian reference in Research, Development and Innovation in the area of Mineral Technology, Environment and Social Inclusion, acting through integrated research groups and projects on strategic issues of national interest.

Renata C. J. Alamino, Keila Valente de Souza, Maria de Fátima D. S. Lima, Francisco R. C. Fernandes and Zuleica C. Castilhos.

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FERNANDES, F. R. C.; LIMA, M. H. R.; TEIXEIRA, N. S. Grandes minas e comunidade: algumas questões conceituais. Rio de Janeiro: CETEM/MCT, 2007. 58p.

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CETEM's Publications: Books and Series

1. SUSTAINABILITY

Essays on the sustainability of mining in Brazil
Maria Laura Barreto, 2001
Book 55 http://www.cetem.gov.br/publicacao/Desenv_sustentavel/desenv_sustentavel.pdf

This volume addresses some of the issues of sustainable development, its challenges and proposals, in the context of a globalized world. It is one of the few texts in the Portuguese language available to the reader and student interested in the solution of the equation that involves providing a growth of the mineral industry, which promotes direct anthropogenic intervention in natural ecosystems, as well as the surrounding society, and the principles of sustainable development.

Mining and sustainable development
Maria Laura Barreto, 2001
Book 59 http://www.cetem.gov.br/publicacao/Desenv_sustentavel/desenv_sustentavel.pdf

The main objective was to obtain an updated and relevant image of mining and sustainable development in the country through a national report, which is the result of research and a participatory process involving the various actors in the Brazilian mineral sector. It presents a summary of the economic, institutional, environmental and social aspects of the Brazilian mineral sector in the period 1980 to 2000.

Mineral resources and territorial sustainability - Vols. I and II - Large Mines and Clusters
Francisco Rego Chaves Fernandes, Maria Amélia Rodrigues da Silva Enríquez e Renata de Carvalho Jimenez Alamino (Eds.), 2011
Book 03 http://www.cetem.gov.br/publicacao/livros/Vol_2_APL_TOTAL.pdf

http://www.cetem.gov.br/publicacao/livros/Vol_1_GRANDES_MINAS_TOTAL.pdf

The research aimed to highlight if the mineral activities currently installed and operating in Brazil generate sustainable net benefits for their communities. A broad thematic research network was established from the pooling of expertise from different institutions (universities and research centers), reinforcing the commitment to current issues such as mineral resources, sustainable development, regional development and the environment.

Mining on indigenous lands: the search of a legal framework

Hariessa Cristina Villas-Bôas, 2005

Book 23 http://www.cetem.gov.br/publicacao/livros/mineracao_terras_indigenas.pdf

Deals with the mining on indigenous lands in Brazil, analyzing the search of legal frameworks.

Gender and child labor in small-scale mining: Brazil, Peru, Argentina and Bolivia

Zuleica Carmen Castilhos, Maria Helena Machado Rocha Lima e Nuria Fernández Castro (Eds.), 2006

Book 29 http://www.cetem.gov.br/publicacao/livros/genero_e_trabalho_infantil.pdf

The book Gender and child labor in small-scale mining in some South American countries is a result of the Cycle of Conferences of the Project "The issue of gender and child labor in South American small-scale mining".

Artisanal and small-scale mining in Latin America

Roberto C. Villas Bôas e Ana Maria Aranibar (Eds.), 2003

Book 48

Held from March 23 to March 29, 2003, in Bolivia, it was divided into three basic steps: first there was a meeting to introduce the participants; the second step involved meeting with authorities and key personalities in Bolivia to discuss science, technology and mining issues; the third one consisted of visits to the Tipuani and Guanay mining centers, which are fundamental to understanding the problems and possible solutions associated with small-scale mining in Bolivia.

Clean technologies in the mining-metallurgical and oil extractive industries

Roberto Villas Bôas e Mário Sanchez, 2006

Book 39http://www.cetem.gov.br/publicacao/livros/Tecnologias%20Limpias%20en%20Industrias%20Extractivas.pdf

Once again, the CYTED Program, the ALFATECLIM Project and AECI get together to perform tests on Clean Technologies, held in Santa Cruz de la Sierra, Bolivia, now discussing the areas of mining, oil and gas.

Land management and the extractive mining industry in Peru

Roberto C. Villas Bôas e Arsenio G. Martinez, 2006

Book 40

This work is the result of a dissertation presented to the International University of Andalucía.

Brazil 2015 technological tendencies

Francisco R. C. Fernandes, Gerson M. M. de Matos, Zuleica Carmem Castilhos, Adão Benvindo da Luz (Eds.), 2007

Book 38 http://www.cetem.gov.br/publicacao/ttb2015.pdf

A prospective study centered on the Vision of the Future and the Systemic and Technological Challenges in the areas of Geosciences and Mineral Technology Develop an agenda of priorities for the technological challenges in order to serve as an aid to decision making on the governmental level.

The Xingu-Tapajós Aquatic Ecoregion

Zuleica Carmen Castilhos e Paulo Andreas Buckup (Eds.), 2011

Book 07 http://www.cetem.gov.br/publicacao/livros/livro_aquarios.pdf

This book presents the main results of an extensive study on the Xingu-Tapajós Aquatic Ecoregion which was achieved through the combined efforts of several scientific institutions, aiming to form a network of scientific, multidisciplinary and multi-institutional research to consolidate the information available, identify knowledge gaps and generate primary data useful for the conservation and sustainable use of natural resources in the region.

Great mines and communities: some conceptual issues

Francisco Rego Chaves Fernandes, Maria Helena Machado Rocha Lima e Nilo da Silva Teixeira, 2007

SED 73 http://www.cetem.gov.br/publicacao/series_sed/sed-73.pdf

This book presents some of the conceptual considerations about mining and sustainable development, the inter-relations between Large Mines and Local Communities and the state of the art socio-environmental responsibility of mining enterprises. The adverse effects of mining to society are of great importance, leading to the necessity of a triple license: mining title, environmental title and social title. The last license must be constructed through the process of consultation, participation and a solid dialogue between enterprise-government-local community.

Large mine and community: study case large Gold Mine in Crixás, Goiás State

Francisco Rego Chaves Fernandes, Maria Helena Machado Rocha Lima e Nilo da Silva Teixeira, 2007

SED 74 http://www.cetem.gov.br/publicacao/series_sed/sed-74.pdf

When a case study performed within the project Large Mine and Community was initiated the expectation was to find a local community with a robust socioeconomic development. However, the study revealed that more than 10 years after industry implementation and continuous operation of a great mineral enterprise, its activity did not bring to the local community and its surroundings municipalities an increase of social and economic indicators that characterize higher life quality.

Panorama of the materials sector and its relations with mining: a contribution to the implementation of R & D lines

Marcello M. Veiga e José Octávio Armant Paschoal, 1991

SED 16 http://www.cetem.gov.br/publicacao/series_sed/sed-16.pdf

At CETEM, this concern is due to the questions: Where is the "world" of materials heading for? Where do minerals fit in it? What is the role of Brazil in the mineral world? And what is CETEM's? In order to structure the search for these responses, we established a Forum of Foresight and Technology Assessment.

Some reflections on science in the low-income economies

Roald Hoffman, 1993

SED 20 http://www.cetem.gov.br/publicacao/series_sed/sed-20.pdf

Food, fuel and materials! These are the issues that population growth, in a global environment, poses to scientist, engineers, economists, politicians and administrators worldwide. How to develop a sustainable environment using a sustainable science? Those are the questions and answers, posed by Nobel Prize in Chemistry Roald Hoffmann in this monography that CETEM is having the honor of issuing as one of its "Estudos e Documentos" publications.

Sustainable development: materials, technology and industrial development in Brazil

Roberto C. Villas Bôas, 1995

SED 25 http://www.cetem.gov.br/publicacao/series_sed/sed-25.pdf

This paper addresses the questions posed by developing sustainable policies regarding materials technology and industrial growth in Brazil. Thus, the questions of minoring energy usage, minimizing environmental impacts and maximizing social satisfaction in pursuing the SD goals in a National Materials policy are discussed.

Agrominerals for Brazil

Francisco Rego Chaves Fernandes, Adão Benvindo da Luz, Zuleica Castilhos (Eds.), 2010

Book 05 http://www.cetem.gov.br/agrominerais/novolivro/agromineirais_para_o_brasil.pdf

The purpose of this chapter is to present a current overview and perspectives on the agrominerals in Brazil in early 2010, which is part of the research conducted under the project "Prospective Study Concerning Agrominerals and Their Uses in the Production of Liquid Biofuels with a Long-Term Vision (2035s).

Mining and economic development: the national issue in development strategies of the mineral sector (1930-1964) Volume I and Volume II

Ana Lúcia Villas-Bôas, 1995

SED 29 http://www.cetem.gov.br/publicacao/series_sed/sed-29II.pdf

This monograph is divided into two volumes and seeks to be a reflection on what mining represented, from a geopolitical point of view, to the national economic development over the period ranging from 1930 to 1964 and from 1964 to 1984.

Geopolitical and strategic elements of the recent materials evolution
Sarita Abagli, 1996
SED 30 http://www.cetem.gov.br/publicacao/series_sed/sed-30.pdf

Prepared as a starting point for further development on issues related to understanding the role of materials in the modern world.

Participatory approach in the management of mineral resources
Carlos César Peiter e Roberto C. Villas Bôas, 2001
SED 51 http://www.cetem.gov.br/publicacao/series_sed/sed-51.pdf

Having as the study a highly concentrated quarries site in the Northwest Region of Rio de Janeiro State, it is described a supports methodology to natural resources management, known as multistakeholder approach. In conclusion, important results concerning this approach are highlighted, ie. the main advantages and the main problems, in order to contribute to new research experiences like that.

Mining sustainability: opportunities for Canada and Brazil
Geraldo Milioli e Mary Louise McAllister, 2004
SED 57 http://www.cetem.gov.br/publicacao/series_sed/sed-57.pdf

Complexity is the by-word for the interconnected social, economic, environmental, and political forces that are shaping the mineral investment and trade environment today. Brazil, which long followed a policy of isolationism, also engaged in the global trend toward trade liberalization in the mid-1990s. These developments, along with many shared characteristics, have led to a number of cooperative ventures between two countries that have a considerable stake in the mining sector: Canada and Brazil.

Geopolitics of the new materials: the case of the small scale mining and new materials developments
Roberto C. Villas Bôas, 1992
STM 59 http://www.cetem.gov.br/publicacao/series_stm/stm-59.pdf

This paper presents the mining businessmen concerns about the declining curves in metals demand, and discusses some issues regarding dematerialization and transmaterialization as affecting the minerals world. The economic cycles and their effects on the consumption of ores and metals are presented. As an illustration, a case study showing the production of a copper salt is presented.

Integrated management systems in small and medium enterprises of the mining-metallurgical sector

Cleber José Cunha Dutra, Paulo Sérgio Moreira Soares e Mario Valente Possa, 2005

SGPA 01 http://www.cetem.gov.br/publicacao/series_sgpa/sgpa-01.pdf

The contribution might offer significant support to improve the general situation of the small and medium enterprises in the Brazilian Mining-Metallurgical Sector, whose characteristics were especially taken into account through the elaboration of the discussions and the implementation schedule presented in this publication.

Brazil-Canada seminar on mine rehabilitation

Juliano Peres Barbosa, Paulo Sérgio Moreira Soares, Brenda Dixon e Bryan Tisch, 2003

Book 43

This work summarizes studies that discuss the most advanced environmental technologies currently employed by leading companies in the Brazilian and Canadian mining sector and those under development at CETEM – Center for Mineral Technology - and CANMET - Canada Centre for Mineral and Energy Technology.

Control of documents and of relevant legislation to organizations in the implementation/operation of EMS

Roberto de Barros Emery Trindade, Gustavo Araujo e Josimar Ribeiro de Almeida, 2005

SGPA 03 http://www.cetem.gov.br/publicacao/series_sgpa/sgpa-03.pdf

This technical indication is aimed at guiding the establishment of procedures to the control of documents applicable to an Environmental Management System.

Basic guidance for planning preventive actions in management systems

Gustavo Henrique de Souza Araújo, Josimar Ribeiro de Almeida, Bianca Mendes Longo, Laís Alencar de Aguiar e Roberto de Barros Emery Trindade, 2006

SGPA 05 http://www.cetem.gov.br/publicacao/series_sgpa/sgpa-05.pdf

This technical indication offers basic elements to establish the necessary procedures on planning preventive actions in management systems.

Strategic planning, competitiveness and sustainability in the industry: two cases of non-metallic in Rio de Janeiro

Gilberto Dias Calaes, 2006

Book 28 http://www.cetem.gov.br/publicacao/livros/Planejamento-Competitividade- Sustentabilidade_IndustriaMineral.pdf

By focusing on the sector of ornamental rocks and gravel, it proposes a planning and management model for the development of mining and quarrying activities, integrating strategic planning, sustainable development and business and sectoral competitiveness.

2. INDICATORS

Sustainability indicators for the mining industry: case studies

Roberto C. Villas Bôas, 2011

Book 4 http://www.cetem.gov.br/publicacao/livros/indicadores-studos-casos-rev08.pdf

Chapter 1 deals with sustainable development and mining; Chapter 2 makes an inquiry about the existence of Sustainable Mining; Chapter 3 deals with the logic of sustainability; Chapter 4 points out the existing actions and indicators in the industry; Chapter 5 describes communities and mining projects; and, at last, Chapter 6 presents four case studies: Geological Prospection, uranium mining, phosphate mining and thorium, respectively.

The extractive mining industry and the transition to sustainable development

Hariessa Cristina Villas Bôas, 2011

Book 10 http://www.cetem.gov.br/publicacao/livros/industria-extrativa-transicao-sustentavel.pdf

Addresses a discussion on the definition and evolution of the concept of social responsibility, the distinction between indicators and indices, sustainability indicators, among others. Finally, it presents a practical guide for the construction of Sustainable Development Indicators for the mining industry.

A review on indicators of sustainability for the minerals extraction industries

Roberto C. Villas Bôas, Deborah Shields, Slavko Šolar, Paul Anciaux e Güven Önal, 2005

Book http://www.cetem.gov.br/publicacao/livros/review_indicators_sustainability.pdf

This book is divided into three parts. The first contains an introduction and overview; the second concerns the indicators themselves, facts, exercises and propositions in America, Europe, Asia, Oceania and Africa; and the third part deals with some important aspects regarding gold sustainability and unit operations.

Indicators of sustainable development for the mining industry

Roberto C. Villas Bôas, 2009

Book http://www.cetem.gov.br/publicacao/livros/GuiaPratico_Indicadores.pdf

This is a practical guide to building sustainable development indicators for the mining industry.

Sustainability indicators and a positive agenda for the Brazilian foreign trade

Saulo Rodrigues Filho, Ilê Maria Krahl, Gian Marco Zampieron, César Antonio Schenini e Jorge Alberto Alcala Vela, 2004

SED 54 http://www.cetem.gov.br/publicacao/series_sed/sed-54.pdf

The current article intends to develop leading sustainable development indicators (SDI) that will enable us to begin to anticipate the direction of development with respect to sustainability.

Assessment of risk to human health: concepts and methodology

Zuleica Carmen Castilhos, Aline Machado de Castro, Alinne dos Santos Ramos, Cristiane Andrade de Lima e Ana Paula de Castro Rodrigues, 2005

SED 65 http://www.cetem.gov.br/publicacao/series_sed/sed-65.pdf

The relationship between the intensity of the environmental pollution and the potential risks to human health can be assessed by the human health risk assessment methodology proposed by USEPA (1989).

Sustainable indicators for the extraction minerals industries

Roberto C. Villas Bôas, 2006

SED 68 http://www.cetem.gov.br/publicacao/series_sed/sed-68.pdf

In recent years sustainability concepts and goals have been successfully extended to mineral resources and a comprehensive literature has been produced on the linkages amongst the goals of sustainable development, mineral resources and social needs.

Mineral production clusters evaluation through the sustainability matrix

Carlos Cesar Peiter; Roberto Cerrini Villas Boas, 2008

SED 75 http://www.cetem.gov.br/publicacao/series_sed/sed-75.pdf

Demonstrates the usefulness of the sustainability matrix as a tool for understanding the impact of public policies and threats to sustainability by highlighting the results obtained by applying it to a Brazilian natural stone cluster.

Evaluation on ecological risk: basic concepts, methodology and case study

Ana Paula de Castro Rodrigues, Zuleica Carmen Castilhos, Ricardo Gonçalves Cesar, Nádia Regina Pereira Almosny, Ana Rosa Linde-Arias, Edison Dausacker Bidone, 2011

SED. 78 http://www.cetem.gov.br/publicacao/series_sed/sed-78.pdf

The ecological risk assessment methodology proposed by USEPA connects the intensity of environmental pollution to associated risks to environment. The objective is to support decisions related to alternatives for programs of environmental control, rehabilitation and/or natural resources management.

Sustainable development indicators concerning the natural stone sector

Carlos Cesar Peiter, 2011

SED 80 http://www.cetem.gov.br/publicacao/series_sed/sed-80.pdf

Presents a historical survey on SD principles devoted to non-renewable natural resources, focusing the mining business, especially the natural/ dimension stone branch.

Neutralization of emission of greenhouse effect gases: an indicator of sustainable development in corporate, individual and environmental responsibilities

Eraldo José Brandão, Luis Gonzaga Santos Sobral, Ana Claudia Nioac de Salles e Sueli Mello Braga, 2008

STA 44 http://www.cetem.gov.br/publicacao/series_sta/sta-44.pdf

The present work aims at formulating a new indicator in the individual and business socio-environmental responsibility taking into account the emissions of greenhouse effect gases (GEG) and the possibility of the neutralization of those emissions.

Selection of status indicators and evaluation of sensitivity of natural systems to anthropogenic

Gustavo Araujo, Lais Alencar de Aguiar, Josimar Ribeiro de Almeida, Paulo Sergio Moreira Soares e Roberto de Barros Emery Trindade, 2005

SGPA 02 http://www.cetem.gov.br/publicacao/series_sgpa/sgpa-02.pdf

Basic orientations are presented for selecting indicators capable of evaluating the sensibility of natural systems to anthropic actions. The evaluation is carried out by means of the following natural components: soil, climate, atmosphere, interior waters, vegetation and fauna.

3. GENERAL ENVIRONMENT

Amazon's mineral resources: some data on the situation and perspectives

Francisco R.C. Fernandes e Irene C.M.H. de Medeiros Portela, 1991

SED 14 http://www.cetem.gov.br/publicacao/series_sed/sed-14.pdf

The Amazon always brings great interest due to the fascination it exerts on the common man to its vastness and natural complexity. Issues concerning the industrialization of the Amazon region carry opinions and suggestions of various schools of economic and social thought. However, what is known about the potential of the Amazon?

Environmental management: an evaluation on the negotiations for the implementation of ISO 14000

Gisela A. Pires do Rio, 1996

SED 33 http://www.cetem.gov.br/publicacao/series_sed/sed-33.pdf

The negotiations progress for the implementation of ISO 14000 as an environmental management system for companies is of particular relevance regarding extractive industries, especially mining and metallurgy, given that this segment will focus on the great power of green pressure which must be faced and counterbalanced by the producers in general.

Policy of sand use in the state of São Paulo: from existing conflicts to possible reconciliations

Hidelbrando Hermann, 1991

SED 18 http://www.cetem.gov.br/publicacao/series_sed/sed-18.pdf

As sand is a basic industrial raw material the areas of construction, metallurgy, steel, glass, and others, it has had increasing acceptance, especially when its availability is made by the consumer market. Hence the conflicts arising within the socioeconomics of the Brazilian municipalities, which often affect irreversibly the soil and water.

Are tropical estuaries environmental sinks or sources?

Egbert K. Duursma, 1995

SAT 06 http://www.cetem.gov.br/publicacao/series_sta/sta-06.pdf

The major terrestrial freshwater and fluvial sediment runoff to the world oceans takes place between 30 N and 30 S. These two discharges occur at different velocities, which have a consequence for contaminant transport. Since most contaminants are 'strongly' adsorbed to particular matter, the conclusion is often drawn that estuaries and coastal regions, where fluvial sediments are deposited, are sinks of contaminants.

Mine decommissioning

Adão Benvindo da Luz e Eduardo Camilher Damasceno, 1996

STA 14 http://www.cetem.gov.br/publicacao/series_sta/sta-14.pdf

Some problems related to the decommissioning of coal and uranium mines in Brazil are discussed. It is observed in this present work that it is easier to decommission a mine when this was forecasted through an environmental impact assessment. Finally, the most important techniques used on tailing decommissioning as well as its controversies are indicated.

4. ENVIRONMENT: MERCURY AND GOLD PROSPECTING

Gold recovery through amalgamation and cyanidation: environmental problems and possible alternatives

Vicente Paulo de Souza e Fernando A. Freitas Lins, 1989

STM 044 http://www.cetem.gov.br/publicacao/series_stm/stm-44.pdf

The paper presents a brief revision of the amalgamation and cyanidation processes and their use in Brazil. Environmental aspects are highlighted by considering the possible harmful consequences of the application of these processes. The various alternative routes are approached, based on previous papers.

Poconé: a field study on the environmental impact of mining

Marcello Mariz da Veiga, Francisco R. C. Fernandes, Luis Henrique Farid, José Eduardo B. Machado, Antônio Odilon da Silva, Luis Drude de Lacerda, Alexandre Pessoa da Silva, Edinaldo de Castro e silva, Rosane V. Martins, João A. Imbassahy, Wolfgrand C. Pfeiffer, Wanderley R. Bastos e Vicente de Paula Souza, 1991

STA 01 http://www.cetem.gov.br/publicacao/series_sta/sta-01.pdf

The city's strategic location near Pantanal's ecological reserve motivated CETEM's decision to establish a program of Environmental Technology Development in the region. There, an artificial lake called "Tanque dos Padres" was found on the "Transpantaneira Highway", silted up over 300.000m3 of mining tailings, considered by local news as a "pot of gold and mercury". Research activities have also addressed

miners, their working relations and the role they play in local society and in the national context.

Preliminary diagnosis of the environmental impacts caused by gold prospecting in Alta Floresta/MT: a case study

Luiz Henrique Farid, Jose Eduardo B. Machado, Marcos P. Gonzaga, Saulo R. Pereira Filho, André Eugênio F. Campos, Nelson S. . Ferreira, Gersino D. da Silva, Carlos R. Tosar, Wolney Câmara, Sandra S. Hacon, Diana de Lima, Vangil Silva, Luiz Roberto M. Pedroso, Ednaldo de Castro E Silva e Lais A. Menezes, 1992

STA 02 http://www.cetem.gov.br/publicacao/series_sta/sta-02.pdf

The team's studies are part of an integrated system, coordinated by CETEM, seeking to carry out a preliminary diagnosis on the environmental effects of gold prospecting in Alta Floresta, Mato Grosso State. The social, human health, biological, environmental geochemistry and mineral technology aspects were appraised, in an endeavor to produce the widest possible picture for understanding the gold prospecting activity. The area's economic importance is reflected directly in the municipality itself which, having been mainly a farming region, became a regional supporting center for gold prospecting in a relatively short time.

Sources of mercury in Brazil

Rui C. Hasse Ferreira e Luiz Edmundo Appel, 1991

SED 13 http://www.cetem.gov.br/publicacao/series_sed/sed-13.pdf

Mercury has been nominated as one of the great villains of aggression to the environment caused by the industrial activity. Where does this mercury come from? Who uses it by industry segment? What is its use rate profile over ten years? How much is it lost in the environment? How much is it consumed in the mines?

Environmental recoveries in stable gold mining: a case study

Irene C.M.H. de Medeiros Portela, 1991

SED 15 http://www.cetem.gov.br/publicacao/series_sed/sed-15.pdf

The mining areas in Brazil have the most varied types of working relationships, which must be identified and analyzed, drawing from them the lessons of how, and by what means, any technological changes may be introduced to the production process in order to, either increase

production or minimize the environmental impact of the production process used. This work, now brought into discussion to the mineral-metallurgical community, presents a case study of the mines of Poconé.

A critical approach to mining legislation: 1967-1989

Maria Laura Barreto, 1993

SED 19 http://www.cetem.gov.br/publicacao/series_sed/sed-19.pdf

The paper sets out the guiding concepts of mining activity, as outlined in the Brazilian Constitution, promulgated in 1988, and how these concepts were presented and discussed during the Constituent Assembly. In addition, it also discusses how the new legal conception of mining is inserted, i.e., the regime that allows mining in the context of its relationship with the whole of the mining activities, as well as environmental issues.

Mercury pollution: technical and legal parameters

Maria Laura Barreto e Anna Christiana Marinho, 1995

SED 27 http://www.cetem.gov.br/publicacao/series_sed/sed-27.pdf

The basic legislation on the effects generated by the presence of heavy metals in the environment, either present criteria for technical parameters that contradict each other, or do not pinpoint the chemical species that causes the need to contain the elements within the tolerated concentration ranges.

Prospecting activities in Brazil: technical, economic and social aspects

Jocy Gonçalo de Miranda, Moacir Cipriani, Raimundo Augusto C. Mártires, Wagner José Giaconi, 1997

SED 38 http://www.cetem.gov.br/publicacao/series_sed/sed-38.pdf

The monograph is to contribute to the discussions, though they are few, in national and international literature on the issues of mining, the aspects of extractive activity, the legal problems that causes almost unnecessary conflicts if the activity would be better perceived by those who deal with the fate of mining in Brazil.

Mercury in the Tapajós Basin

Roberto C. Villas Bôas, Christian Beinhoff e Alberto Rogerio da Silva, 2001
Book 49 http://www.cetem.gov.br/publicacao/Mercury/Mercury_in_the_Tapajos_Basin.pdf

The initiative of the United Nations Global Environment Fund, through the project removal of barriers to the reduction of global mercury pollution from artisanal gold mining, which will develop studies to create a model of sustainable mining in the region, deserves government support.

Evaluation of the potential accumulation of mercury in the fish tanks (predicted) of Jirau and Santo Antonio, Rio Madeira, RO

Zuleica Carmen Castilhos e Ana Paula de Castro Rodrigues, 2008
SED 76 http://www.cetem.gov.br/publicacao/series_sed/sed-76.pdf

In the Amazon region, mercury has been used during amalgamation of gold and, as a consequence, high quantities of mercury have been released in the environment. Actually, the increase of energy production in order to sustain the Brazilian economic growth is necessary, and the major hydro electrical potential is located in Amazonian rivers.

Mercury in the Amazon: a chemical time bomb?

L. D. Lacerda e W. Salomons, 1992
STA 03 http://www.cetem.gov.br/publicacao/series_sta/sta-03.pdf

This report deals with the increasing use and wide spread mercury dispersion through the environmentally sensitive Amazon region and presents the results of this study. The first seven chapters provide an overview of the current-though-scarce knowledge that is available on the mercury behavior in the Amazon. The final chapter gathers the information available and provides some speculation on the fate of mercury in the complex ecosystem of the Amazon rainforest.

Study on the environmental impacts of mineral extraction and mercury pollution in Tapajos (pre-diagnosis).

Rita Maria Rodrigues, Artur F. S. Mascarenhas, Ambrósio Hajime Ichihara, Terezinha Maria Cid Souza, Edison Dausacker Bidone, Victor Bellia, Sandra Hacon, Alberto Rogério B. da Silva, João Bosco P. Braga e Bernard Stilianidi Filho, 1994
STA 04 http://www.cetem.gov.br/publicacao/series_sta/sta-04.pdf

A socioeconomic diagnosis and evaluation of potential associations; identification and analysis of impacting factors; development, improvement of extraction technologies, beneficiation and recovery of gold and mercury; alternative occupation combined with mineral extraction; and wide dissemination of technologies, environmental data and information necessary for the formation of a public awareness on the need to preserve environmental quality.

Use of water hyacinth, Eichornia crassipes (Mart.) Solms, in the treatment of effluents containing cyanide

Marcus Granato, 1995

STA 05 http://www.cetem.gov.br/publicacao/series_sta/sta-05.pdf

The two-step study was developed in laboratory and seeked to evaluate the potential use of water hyacinth, Eichornia crassipes (Mart.) Solms, in the treatment of effluents containing cyanide.

Assessment of heavy metal pollution in gold mining

Saulo Rodrigues Filho e John Edmund L. Maddock, 1995

STA 07 http://www.cetem.gov.br/publicacao/series_sta/sta-07.pdf

Gold has been exploited in the Poconé region, Mato Grosso State, Brazil, over the past 13 years using mining methods. In this research, background levels of metals were determined by analyzing sediments and soils unaffected by mining activities, located upstream of the anthropogenic inputs. The study made in Poconé focuses on Hg, Cu, Pb, Zn, Fe and Mn. In addition, the study aims to evaluate the level of contamination in sediments, soils and water, taking into account drainage waters directly affected by gold mining.

Heavy metals in estuarine sediments: mangrove swamps of the Subaé and Paraguaçu tributary rivers of Todos os Santos Bay, Bahia, Brazil

J. F. Paredes, et al, 1995

STA 09 http://www.cetem.gov.br/publicacao/series_sta/sta-09.pdf

This work examined the dispersion of heavy metals in sediments of mangrove swamps and bottom drainage of the two major basins in western Recôncavo da Bahia, corresponding to the Paraguaçu River estuarine complex and the Subaé River estuary. The research conducted allowed to diagnose a critical situation in relation to the River Subaé estuary.

Heavy metals in the Poconé and Alta Floresta sub-basins

Saulo Rodrigues Filho, 1995

STA 10 http://www.cetem.gov.br/publicacao/series_sta/sta-10.pdf

Gold has been exploited in the Poconé region, located in the State of Mato Grosso, Brazil, during the past 13 years by prospecting activity. In the present research background levels of metals were determined through the analysis of sediments and soils unaffected by mining activities, located upstream of the anthropogenic inputs.

Environmental diagnosis of areas subjected to gold mining in Rio Preto-MG

Antônio José L. A.Ramos e Saulo Rodrigues Filho, 1996

STA 11 http://www.cetem.gov.br/publicacao/series_sta/sta-11.pdf

The alluvial gold prospecting expanded in Brazil during the 80's caused by the increase of gold quotation in the international market. This gold rush occurred not only in the Amazon region but also in others places, as in the Rio Preto country, located in the Southeast Region, near Brazil's three largest metropolitan regions.

Batch and continuous heavy metals biosorption by a brown seaweed

Antônio Carlos A. da Costa, Luciana Maria S. de Mesquita e João Tomovsky, 1996

STA 12 http://www.cetem.gov.br/publicacao/series_sta/sta-12.pdf

Heavy metals biosorption by a dry biomass of a brown alga was studied. A continuous system was used for treating a complex effluent of a Brazilian zinc-producing company. Preliminary results indicate a rapid kinetics for the process.

Mercury emissions from burning of amalgam: a study of air, soil and dust contamination in Poconé / MT

Alexandre Pessoa da Silva, et AL, 1996

STA 13 http://www.cetem.gov.br/publicacao/series_sta/sta-13.pdf

The burning of the Au-Hg amalgam at gold shops close to gold mining sites have been indicated as an important source of metallic mercury emission in urban areas. This constitutes a serious occupational hazard and a source of contamination to humans living nearby these shops. To

evaluate these emissions, samples of air, soil and domestic dust were collected from 53 houses located at Poconé, Mato Grosso State.

Itaituba Project: program on environmental technology development

Alexandre Pessoa da Silva, 1997

STA 18 http://www.cetem.gov.br/publicacao/series_sta/sta-18.pdf

During 1992 and 1993, CETEM carried out environmental studies on the impacts caused by gold mining activities in the Rato river basin (Pará State, Brazil).

Mercury exposure and health effects among urban residents due to gold commercialization in Poconé/MT, Brazil

Volney de M. Câmara, Alexandre Pessôa da Silva, Marcus Vinicius Maciel, Fátima Pivetta e Maurício Andrade Perez, 1997

STA 19 http://www.cetem.gov.br/publicacao/series_sta/sta-19.pdf

The main objective of this study was to evaluate the levels of exposure and health effects of residents from the city of Poconé, State of Mato Grosso, Brazil, caused by metallic mercury emissions to the atmosphere from gold-buying establishments.

Optimization of mercury sampler in vapor and atmospheric particulate phases

Rozane V. Marins, Jailson B. de Andrade, Pedro A. P. Pereira, Elizabeth C. Paiva e Heloisa H. M. Paraquetti, 1999

STA 21 http://www.cetem.gov.br/publicacao/series_sta/sta-21.pdf

To test and calibrate a system, based on annular gold coated denuders, for sampling mercury species (vapor and particulate) in the atmosphere of urban and forested sites of the Amazon region in Brazil (Alta Floresta).

Mercury distribution in soils and sediments in the region of Alta Floresta, MT

Luiz Drude de Lacerda, Mário Gomes Ribeiro Jr., Margareth de Souza, Gisele Antunes Ayres, 1999

STA 23 http://www.cetem.gov.br/publicacao/series_sta/sta-23.pdf

Mercury distribution in superficial soils of the rural region of Alta Floresta was strongly influenced by the location of the potential sources of Hg and by the vegetation.

Mechanisms of physico-chemical interaction and mobility of mercury in soils, sediments and tailings from gold mining

Ricardo Melamed e Roberto C. Villas Bôas, 2002

STA 25 http://www.cetem.gov.br/publicacao/series_sta/sta-25.pdf

Mercury is used in its elemental form in various industrial sectors, such as: in the sodium-chlorine industry, in the production of fluorescent lamps and recovery of gold in mining sites. Industrial emissions of mercury, in general, have been contributing drastically to the biomagnifications of the metal in the food chain, which is of great concern for governmental companies and environmentalists. Experiments conducted in laboratory investigated the physico-chemical interactions of Hg in tailings, soils and river sediments from regions of intense gold mining activities in Brazil.

Temporal evolution of heavy metal pollution in sediments of the Paraíba do Sul river, state of Rio de Janeiro

Saulo Rodrigues Filho, Mário Gomes Ribeiro Júnior, Arnaldo Alcover Neto, Marilu de Menezes Silva, Eurico Zimbres, Allegra Viviane Yallouz, Zuleica Castilhos, Anderson Rocha da Silva, João Felipe Mitre de Araújo, 2002

STA 26 http://www.cetem.gov.br/publicacao/series_sta/sta-26.pdf

The present study aims to reconstruct the recent history of the heavy metal pollution from geochemical and geochronological investigations in floodplain sediments of the Paraíba do Sul River, State of Rio de Janeiro, Brazil. Matter of concern in a highly industrialized region, surface waters of the Paraíba do Sul River are responsible for 80% of the water supply for Rio de Janeiro City.

Mercury accumulation in the Amazonian peacock bass (Cichla sp.)

Ysrael Marrero Vera, Roberto José de Carvalho, Zuleica Carmen Castilhos e Maria Josefina Reyna Kurtz, 2007

SGPA 08 http://www.cetem.gov.br/publicacao/series_sgpa/sgpa-8_final.pdf

The aim of this work is to study the bioaccumulation of mercury in peacock bass (Cichla sp.), a top predator in the food chain, through a mathematical model.

5. ENVIRONMENT THEME AND OTHER

Batch and continuous heavy metals biosorption by a brown seaweed
Antônio Carlos A. da Costa, Luciana Maria S. de Mesquita e João Tomovsky, 1996
STA 12 http://www.cetem.gov.br/publicacao/series_sta/sta-12.pdf

Heavy metals biosorption by a dry biomass of a brown alga was studied. A continuous system was used for treating a complex effluent of a Brazilian zinc-producing company. Preliminary results indicate a rapid kinetics for the process.

Transport of toxic chemicals through soils: an environmental challenge for the mining industry
Ricardo Melamed, 1997
STA 16 http://www.cetem.gov.br/publicacao/series_sta/sta-16.pdf

The quality of ground and surface waters should be of primary concern in a rational waste and tailings disposal technology. This paper describes the importance of sorption mechanisms, as a result of the type of surface-chemical interaction, on the mobility of toxic chemicals.

An emerging biotechnology for metal containing waste water treatment
Antônio Carlos A. da Costa, 1997
STA 17 http://www.cetem.gov.br/publicacao/series_sta/sta-17.pdf

Well defined steps including the selection of a suitable biomass to be used as metals biosorbent, conduction of continuous scale experiments with synthetic and real effluents, studies on the most suitable conditions for metals desorption and also the scale-up and economic evaluation of a continuous unit for the treatment of heavy metals contaminated solutions were done.

A flow-by reaction system for removing heavy metals from a biological process stream
Luis G. S. Sobral, 1999
STA 20 http://www.cetem.gov.br/publicacao/series_sta/sta-20.pdf

In this study the removal of zinc, cadmium and copper, from an aqueous sulphate solution, derived from the biomass desorption process.

Water resources and wastewater treatment in mining
Ana Paula Almeida e Adão Benvindo da Luz, 2001
STA 24 http://www.cetem.gov.br/publicacao/series_sta/sta-24.pdf

Some aspects related to the politics and the management of the water resources, also approaching some basic concepts of hydrogeology. Traditional and potential processes for mining wastewater treatment are discussed.

Flotation applied to the removal of heavy metals
Maurício Leonardo Torem e Rui de Góes Casqueira, 2003
STA 28 http://www.cetem.gov.br/publicacao/series_sta/sta-28.pdf

Among the most important parameters which have to be examined when treated waste waters are going to be recycled is their content of heavy and toxic metals, due to ever decreasing metal disposal limits.

Evaluation on the potential of acid drainage from tailings from the mining industry
J. R. J. Zumarán Farfan, O. Barbosa e Vicente Paulo de Souza, 2004
STA 29 http://www.cetem.gov.br/publicacao/series_sta/sta-29.pdf

The objective of the present work is to evaluate the potential of acid drainage generation from tailings derived of coal factory treatment located in the state of Santa Catarina and of sediments dragged from the Jacarepaguá lagoon in the state of Rio de Janeiro, Brazil.

Passive systems technology for the treatment of acid mine drainage
Roberto de Barros Emery Trindade e Paulo Sérgio Moreira Soares, 2004
STA 30 http://www.cetem.gov.br/publicacao/series_sta/sta-30.pdf

Acid mine drainage (AMD) is the acid aqueous solution generated when sulphide minerals found in mining residues (tailings or overburden) are oxidized in the presence of water. AMD is one of the most serious environmental impacts associated to the mining activity.

Production of sulphide in UASB-type reactor and its potential application in the removal of heavy metals from waste
Andréa Camardella de Lima Rizzo e Selma Gomes Ferreira Leite, 2004
STA 32 http://www.cetem.gov.br/publicacao/series_sta/sta-32_I.pdf

Many industrial and mining operations produce heavy metal and sulphate bearing effluents and leachates. This work reports the results,

obtained in a continuous bench scale unit, using a UASB reactor, where biological sludge acclimatization was undertaken for sulphate reduction.

The transport of heavy metals in soil in the context of solid waste disposal

Paulo Sergio Moreira Soares, Lidia Yokoyama e Denize Dias de Carvalho Freire, 2005

STA 33 http://www.cetem.gov.br/publicacao/series_sta/sta-33.pdf

Basic concepts of heavy metal transport in soil in the context of industrial solid waste disposal. Complementary, some examples are presented to illustrate the application of these concepts in the choice of the strategies for remediation of soils contaminated with heavy metals.

Study of vermiculite as an adsorbent of oil and heavy metal

José Fernandes de Oliveira Ugarte e Marisa Bezerra de Mello Monte, 2005

STA 34 http://www.cetem.gov.br/publicacao/series_sta/sta-34.pdf

The results of adsorption and desorption show that vermiculite absorbed high amounts of oil, with 98% efficiency and releasing 90% of the incorporated oil, apart from keeping the hydrophobic proprieties of the material to be used in further tests.

Removal of mercury from the chlorine-soda industry wastewater using *sargassum sp.*

Luis Gonzaga Santos Sobral, André Luiz Ventura Fernandes, Renata de Barros Lima, Débora Monteiro de Oliveira e Priscila Gonçalves Xavier, 2006

STA 36 http://www.cetem.gov.br/publicacao/series_sta/sta-36.pdf

In this study, the evaluation of ionic mercury uptake contained in wastewater by using the macro algae *Sargassum sp.*, easily found in the northeast coast of Brazil, was accomplished.

Bioremediation of soils contaminated by petroleum: emphasis on the use of bioreactors

Andréa C. de Lima Rizzo, Selma Gomes Ferreira Leite, Adriana Ururahy Soriano, Ronaldo Luis Correa dos Santos e Luis Gonzaga dos Santos Sobra, 2006

STA 37 http://www.cetem.gov.br/publicacao/series_sta/sta-37.pdf

The high potentiality of microorganisms use, pointed out in the literature as degrading agents of several substances, combined to the ever frequent use of biotechnology, indicate the biological treatment as one of the most efficient means of reducing the adverse effects of hydrocarbons on the environment.

Recovery of precious metals from anodic sludge from copper, silver and gold electro refining processes

Gabrielle Nogueira Bard, Luis Gonzaga Santos Sobral e Renata de Barros Lima, 2006

STA 38 http://www.cetem.gov.br/publicacao/series_sta/sta-38.pdf

This research work aimed at evaluating the ways of treating the anode slimes from the gold, silver and copper electro refining processes.

Phytoremediation: the state of the art

Débora Monteiro de Oliveira, Diego Valentim Crescente Cara, Priscila Gonçalves Xavier, Luis Gonzaga dos Santos Sobral, Renata de Barros Lima e Alexandre Loureiro de Almeida, 2006

STA 39 http://www.cetem.gov.br/publicacao/series_sta/sta-39.pdf

Phytoremediation is a technology that uses vegetable systems as a decontamination agent in order to remediate water and polluted soils for organic (hydrocarbons, pesticides, chlorinated and nitrogenous compounds, and explosives) and inorganic (metals and radioactive elements) pollutants.

State of the art of physical-chemical processes for removing selenium from industrial wastewater

André Luiz Ventura Fernandes, Ronaldo Luiz Correia dos Santos e Luis Gonzaga Santos Sobral, 2006

STA 40 http://www.cetem.gov.br/publicacao/series_sta/sta-40.pdf

An extensive review of the literature has been performed to identify selenium emission sources to the environment, its occurrence in crust of the earth and technologies for the removal of selenium from a variety of wastewaters.

Biological processes for the removal of selenium from effluents

Andrea C. de Lima Rizzo, Valéria Millioli, Judith Liliana S. Lemos, Érica

Valdman e Ronaldo Luiz Correia dos Santos, 2007
STA 42 http://www.cetem.gov.br/publicacao/series_sta/sta-42.pdf

Selenium toxicity has been well discussed in the last decades representing one of the largest environmental problems of the present time.

Review on the use of microorganisms in the bioremediation of industrial wastes containing heavy metals

Judith Liliana Solórzano Lemos, Marion Cony Carlos, Yaci Pira-Tatá Maria Marcondes Farias e Ronaldo Luiz Correa dos Santos, 2008
STA 43 http://www.cetem.gov.br/publicacao/series_sta/sta-43.pdf

This work aims to explore the metal-microorganism interaction mechanisms as well as the application of some remediation methods in contaminated areas and to identify microorganisms with better potential for metal removal for future application in bioremediation.

Use of filamentous fungi in the bioremediation of soils contaminated by oil: state of the art

Sabrina Dias de Oliveira, Judith Liliana Solórzano Lemos, Claudia Afonso Barros e Selma Gomes Ferreira Leite, 2008
STA 45 http://www.cetem.gov.br/publicacao/series_sta/sta-45.pdf

The present work brings together a number of scientific papers and other recent references to discuss issues relevant to the current juncture, such as soil pollution by oil spill, types of appropriate biological treatments with emphasis on bioremediation, and perspectives of implementation of fungal filaments in the processes of degradation.

Implementation of technologies for the remediation of groundwater contaminated by gasoline at service stations: a field study and in microcosms

Aline Alves Soares, Cláudia Duarte da Cunha e Selma Gomes Ferreira Leite, 2008
SAT 48 http://www.cetem.gov.br/publicacao/series_sta/sta-48.pdf

This work aims, preliminary, at investigating the soil and groundwater contamination by gasoline in a gas station placed in a Rio de Janeiro metallurgic industry.

Removal of oil and arsenic from industrial wastewater using retorted shale

Patrícia Ferreira Prado, Cláudia Duarte da Cunha, Selma Gomes Ferreira Leite e Fernando Jorge Santos Oliveira, 2008

STA 49 http://www.cetem.gov.br/publicacao/series_sta/sta-49.pdf

The present work evaluated the reuse of retorted shale as a potential sorbent material for arsenic and oil from an industrial effluent.

Bioremediation of soil impacted with crude oil: assessing the potential use of surfactants

Valéria Souza Millioli, Luiz Gonzaga Santos Sobral, Eliana Flávia Camponese Sérvulo e Denize Dias de Carvalho, 2008

SAT 50 http://www.cetem.gov.br/publicacao/series_sta/sta-50.pdf

The aim of this work was to investigate some works that use surfactant as auxiliary to bioremediation as well as to carry out some bibliography review on soil, petroleum, surfactants and their applicability, and some toxicological methods that can be used to investigate the behavior of surfactants when added to the soil.

Using coconut husk fiber as a support for biofilm formation to treat wastewater

Bianca de Souza Manhães de Azevedo, Andréa Camardella de Lima Rizzo, Selma Gomes Ferreira Leite, Luis Gonzaga dos Santos Sobral, Danielle Reichwald e Gustavo Mendes Walchan, 2008

SAT 51 http://www.cetem.gov.br/publicacao/series_sta/sta-51.pdf

The use of supports for microorganisms adhesion and biofilm growth with capacity to remove organic and inorganic pollutants present in wastewater is emphasized by environmental biotechnology. For this reason, the study on new kinds of supports for biofilm growth has been widely used, such as: polymers, ceramics, crushed stone, rice husk and coconut husk, emphasizing the last one as a promising material, as it is a low cost and easy-to-find waste.

Bioleaching: use of micro-organisms for metals extraction

Débora Monteiro de Oliveira, Eliana Flávia Camporense Sérvulo, Luis Gonzaga Santos Sobral e Gabriel Henrique Costa Peixoto, 2010

STA 53 http://www.cetem.gov.br/publicacao/series_sta/sta-53.pdf

This work aims at presenting a literature review on bioleaching approaching the main aspects of the process, namely: the microorganisms involved, bioleaching mechanisms and factors influencing that process.

Evaluation on the bioavailability of organic contaminants in contaminated soils

Maria Clara S. C. L. Telhado, Selma Gomes Ferreira Leite, Andréa Camardella de Lima Rizzo e Danielle Reichwald Claudia D. da Cunha, 2010

STA 56 http://www.cetem.gov.br/publicacao/series_sta/sta-56.pdf

Bioavailability of organic contaminants in soils, under a process perspective, can be defined as physical, chemical and biological interactions that determinate the exposure of organisms to chemicals in soils and sediments. The present work investigated if the Hidroxypropyl –Beta – Cyclodextryn.

Ecotoxicological evaluation of effluents from the coal industry

Zuleica Carmen Castilhos, Silvia Gonçalves Egler, Hudson Jean Bianquini Couto, Silvia Cristina Alves França, Jorge Rubio, Cristiane Moreira dos Reis Pereira, Patricia Correa Araujo, 2011

STA 61 http://www.cetem.gov.br/publicacao/series_sta/sta-61.pdf

Effluents from the benefaction of coal processing, after undergoing different treatments, were evaluated through ecotoxicological tests.

Bioremediation of groundwater contaminated with gasoline and molecular analysis on the present bacterial community

Cláudia Duarte da Cunha, Selma Gomes Ferreira Leite, Alexandre Soares Rosado e Mário do Rosário, 2008

STA 47 http://www.cetem.gov.br/publicacao/series_sta/sta-47.pdf

The evaluation of some conditions such as the presence of hydrocarbonoclastic microorganisms in the contaminated site and the presence of key enzymes and biosurfactant in the biodegradation process is necessary for the implementation of the best strategy for treatment.

Radiological impacts of the phosphate industry

Horst Monken Fernandes, Mônica A. Pires Rio e Mariza R. Franklin, 2004

SED 56 http://www.cetem.gov.br/publicacao/series_sed/sed-56.pdf

It has been recognized that several non-nuclear industries have the potential to cause significant environmental and occupational radiological impacts. The main issue arising from their operations is related to the generated wastes/residues. The objective of the present work was to review the potential consequences of the use of the residues as building material and in the agriculture. A study case on one Brazilian phosphate industry is also presented.

Implications of soil chemical interactions on the management of fertilizers in oxisols

Ricardo Melamed, 2004

SED 59 http://www.cetem.gov.br/publicacao/series_sed/sed-59.pdf

The Brazilian agriculture is predominantly established in Oxisols, soils that are in an advanced stage of weathering, with a predominance of Fe and Al oxides. The focus of this chapter is an approach on the rational management of fertilizers in crop production systems emphasizing physico-chemical aspects and interaction of Oxisols.

Fertilizers and sustainability: potassium in Brazilian agriculture, sources and alternative routes

Marisa Nascimento e Francisco E. de Vries Lapido Loureiro, 2004

SED 61 http://www.cetem.gov.br/publicacao/series_sed/sed-61.pdf

It is in this context that the present paper analyzes the potassium problem and the concept of sustainable agriculture, or still, of an agriculture that satisfies the economic, ecological and social parameters in a local, national and global domain, as much as in the present as in the future. This work summarizes the main information about the macronutrient potassium. Traditional and potential sources, economic and geostrategic aspects are presented.

Importance and role of fertilizers in a sustainable agriculture

Francisco E. Lapido Loureiro e Marisa Nascimento (Eds.), 2003

SED 53 http://www.cetem.gov.br/publicacao/series_sed/sed-53.pdf

These 14 papers on fertilizers and sustainability in agriculture - a mining, chemical and metallurgical approach will be published initially in electronic form, and later as a book. These papers will consider, in the Brazilian framework, conventional and alternative

Manufacture of an organophosphated fertilizer

Carlos Alberto Ikeda Oba, 2004

SED 62 http://www.cetem.gov.br/publicacao/series_sed/sed-62.pdf

The project demonstrates the alternative production of an organophosphated fertilizer, based in the Humifert process developed by the French researches F. Sternicha and A. Bernard, from a simple manufacture through the nitric solubilization of the phosphate with the mixture of grounded phosphatic rocks and the humidified organic material.

Criticism to the Brazilian model of high solubility phosphate fertilizers

Arthur Pinto Chaves e Carlos Alberto Ikeda Oba, 2004

SED 63 http://www.cetem.gov.br/publicacao/series_sed/sed-63.pdf

The project demonstrates a criticism to the model of the manufacture of high solubilization fertilizer implemented in Brazil after being imported from industrialized countries located in temperate climate regions.

Micronutrients in Brazilian agriculture: availability, utilization and perspectives

Álvaro Vilela de Resende, 2004

SED 64 http://www.cetem.gov.br/publicacao/series_sed/sed-64.pdf

The use of micronutrients in the Brazilian agriculture is a complex and controversial issue. The micronutrients contents in soil are very low and their dynamics are strongly influenced by soil nature.

Bacterial leaching of low-grade copper sulfate from Caraíba

Vicente Paulo de Souza, 1980

STM 12 http://www.cetem.gov.br/publicacao/series_stm/stm-12.pdf

Bacterial leaching tests of low-grade copper ore from Caraíba (Bahia, Brazil) were carried out under ideal conditions using bacteria isolated from the ore. Under such ideal conditions, copper extraction achieved 51% in 30 days.

Cyanide degradation through sodium hypochlorite

Antonio Carlos Augusto da Costa, 1992

SMT 60 http://www.cetem.gov.br/publicacao/series_stm/stm-60.pdf

The use of sodium hypochlorite was evaluated for the degradation of cyanide solutions and metallic cyanide complexes, in laboratory scale, in agitated reactors.

Thiourea and bromine as alternative lixiviants in gold cyanidation

Roberto de Barros Emery Trindade, 1994

STM 67 http://www.cetem.gov.br/publicacao/series_stm/stm-67.pdf

A review on the main publications on thiourea and on the system bromine/bromide as alternative reagents to cyanide in the hydrometallurgy of gold are presented, including the work developed at CETEM with the system "bromide + oxidizing agent".

Mineral beneficiation: the potential of microorganisms as flotation reagents

Luciana Maria Souza Mesquita, Fernando A. Freitas Lins e Maurício Leonardo Torem, 2002

STM 81 http://www.cetem.gov.br/publicacao/series_stm/stm-81.pdf

Recent literature has demonstrated the possibility of use of microbial species as flotation reagents in the selective separation of hematite-quartz, corindon-quartz, apatite-dolomite, pyrite-coal and chalcopyrite-pyrite systems, in the bioflotation process.

Assessment of land use in the surroundings of Porto Primavera Hydroelectric using geoprocessing and remote sensing

Luzia Alice Ferreira de Moraes, Ronaldo Luiz Correa dos Santos, Edvard Elias de Souza Filho e Luis Gonzaga Santos Sobral, 2006

SGPA 06 http://www.cetem.gov.br/publicacao/series_sgpa/sgpa-06.pdf

This technical contribution aimed at identifying the impacts on land use, especially in relation to land degradation caused by flooding in the surroundings of Porto Primavera dam in São Paulo, Brazil.

Methodology of geoprocessing application in the assessment of heavy metal contamination in soil: a case study in a confined area of industry

Luzia Alice Ferreira de Moraes, Ronaldo Luiz Correa dos Santos e Luis Gonzaga dos Santos Sobral, 2006

SGPA 07 http://www.cetem.gov.br/publicacao/series_sgpa/sgpa-7.pdf

This paper demonstrates the methodology of the geoprocessing tool in the evaluation of heavy metal contamination within an industry, using terrain numerical model (TNM).

Environmental impacts in the Guapi/Macacu river basin and the consequences for water supply in the municipalities of eastern Guanabara Bay

José Roberto da Costa Dantas, Josimar Ribeiro de Almeida e Gustavo Aveiro Lins, 2007

SGPA 10 http://www.cetem.gov.br/publicacao/series_sgpa/sgpa-10_final.pdf

The importance of the preservation of the Guapi/Macacu river basin was shown during the years 2001 and 2002 as there were serious problems regarding water supply in three main cities of eastern Guanabara Bay.

Evaluation of environmental impacts: a case study

Jaqueline de Oliveira Abi-Chahin, Josimar Ribeiro de Almeida e Gustavo Aveiro Lins, 2008

SGPA 11 http://www.cetem.gov.br/publicacao/series_sgpa/sgpa-11_final.pdf

Highways are vital for the growth of a nation's economy; however, the ecological impacts they cause have been considered by many authors as one of the largest threats to biodiversity.

Control of water pollution generated by automotive activities

Marcelo Bernardes Secron, Gandhi Giordano e Olavo Barbosa Filho, 2010

SGPA 12 http://www.cetem.gov.br/publicacao/series_sgpa/sgpa-12.pdf

This study assessed thirteen different automotive activities in the Rio de Janeiro metropolitan area using a monitoring protocol, involving the following parameters: MBAS, COD, oils and greases, suspended solids, settable solids and pH.

Methodology for monitoring water quality in Southern Santa Catarina coal basin: a management tool for environmental pollution management

Zuleica Carmen Castilhos, Edison Dausacker Bidone, Ricardo Gonçalves

Cesar, Silvia Gonçalves Egler, Nadja Zim Alexandre, Marcus Bianchinni e Teresinha Nascimento, 2010
SGPA 13 http://www.cetem.gov.br/publicacao/series_sgpa/sgpa-13.pdf

This work aims to assess contaminants fluvial fluxes and their subsequent mass balances in three basins impacted by coal mining in the Coal Region of Santa Catarina State: Araranguá, Tubarão and Urussanga.

Brazilian coal: technology and environment
Paulo Sergio Moreira Soares, Maria Dionísia Costa dos Santos, Mario Valente Possa, 2008
Book 24

It discusses the various environmental aspects of coal mining: mining, processing, impacts on the physical environment, revegetation, phytoremediation and management of impacted areas.

Analisis y evaluaciones de impactos ambientales
Josimar Ribeiro de Almeida e Paulo Sergio Moreira Soares, 2008
Book 32 http://www.cetem.gov.br/publicacao/livros/analisis.htm

Contains fundamentals and applications of different techniques and seeks to meet the professionals who, in their activities, engaged in the practice of analysis and evaluation of environmental impacts.

Fertilizers: agroindustry and sustainability
Francisco E. Lapido-Loureiro, Ricardo Melamed e Jackson de Figueiredo Neto (Eds.)
Book 12 CD_Rom

There are 25 chapters grouped into five thematic sections, preceded by the "Foreword", which gives an overview on the development and characterization of Brazilian agribusiness.

Biohydrometallurgical processes: A practical approach
Luis Gonzaga Santos Sobral, Débora Monteiro de Oliveira e Carlos Eduardo Gomes de Souza, 2011
Book 02 http://www.cetem.gov.br/publicacao/livros/banner_biohydrometallurgical.pdf

Discusses the practical aspects of biohydrometalurgicos processes such as the bioleaching of sulfide minerals, bio-availability of nutrients

from agro-mineral bioremediation of soils contaminated with oil, among others.

Ingeniería ambiental subterránea y aplicaciones

Vidal Félix Navarro Torres e Carlos Dinis da Gama, 2012
Book 01 http://www.cetem.gov.br/publicacao/livros/Livro_Ing_Amb_Subterranea_v2.pdf

The present book concerns the underground environment engineering (UEE) based on the concept of a dynamic system of mutual and integral interaction of four important environmental domains: underground atmosphere, groundwater, rock and the biological component (man).

Rock poweder as an alternative fertilizer for sustainable production systems in tropical soils

Ricardo Melamed, José Carlos Gaspar e Norbert Miekeley, 2007
SED 72 http://www.cetem.gov.br/publicacao/series_sed/sed-72.pdf

The elevated demand of the Brazilian agriculture for fertilizers, which cannot be fulfilled by the national industry, could be additionally incremented by the utilization of rock powder, which is a product obtained via simple processing of raw materials with ample geographic distribution, diminishing imports expenses and amplifying the alternatives for the consumer market.

Use of marble waste for cosmetics production

Carolina Nascimento de Oliveira, Roberto Carlos da Conceição Ribeiro e Joedy Patrícia Cruz Queiroz, 2010
STA 54 http://www.cetem.gov.br/publicacao/series_sta/sta-54.pdf

Processing of natural stones generates a significant amount of waste and it represents an environmental problem. In order to find ways to mitigate the impact generated by such waste, its use in the cosmetics industry is suggested with emphasis on soaps.

Use of waste from the cutting of ornamental rocks for acid correction and tropical soils liming

Ramires Ventura Machado, Roberto Carlos da C. Ribeiro, Felipe Vaz Andrade, Renato Ribeiro Passos e Luiz Felipe Mesquita, 2010
STA 55 http://www.cetem.gov.br/publicacao/series_sta/sta-55.pdf

This study aimed at evaluating the use of waste arising from the cutting of stones as soil liming, or as sources of nutrients for agriculture. Experiments were accomplished in laboratory (incubation) and in a greenhouse.

Use of waste from ornamental rocks in asphalt mixtures

Roberto Carlos da C. Ribeiro, Julio Cesar G. Correia, Peter Rudolf Seidl, Jorge Barbosa Soares, Salvador Luiz M. de Almeida e Eduardo A. de Carvalho, 2007

STM 87 http://www.cetem.gov.br/publicacao/series_stm/stm-87.pdf

The municipal district of Santo Antônio de Pádua, northwest of the Rio de Janeiro State, has an expressive number of ornamental rocks quarries and sawmills. Research conducted by CETEM's made possible the construction of tanks for the collection of residues in sawmills, as well as its use in cement. In this context, the idea of using this waste in the mineral composition of asphalt mixtures, replacing the commonly used mineral aggregates, arises and gives an important contribution to reducing environmental impacts in the area and to paving costs as well.

Industrial minerals and rocks as elements for sustainable development

Benjamin Calvo Perez, 2001

SRMI 03 http://www.cetem.gov.br/publicacao/series_srmi/srmi-03.pdf

This work presents an appraisal on the Industrial Mineral and Rocks, relating their importance as raw materials with ample use in the developed society.

Use of waste from quarries of Santo Antônio de Pádua – RJ

Salvador Luiz Matos de Almeida e Arthur Pinto Chaves, 2002

SRMI 06 http://www.cetem.gov.br/publicacao/series_srmi/srmi-06.pdf

Crushing and screening studies were performed with waste from a quarry of Santo Antônio de Pádua – Rio de Janeiro State, in order to produce aggregate for construction. The results indicated a crushed cubical shape, which is a great feature for the construction industry. The project has an environmental appeal since it promotes an indisputable advantage of wastes that are generated today in very significant amounts and are arranged in a disorderly manner causing enormous environmental impact.

Pegmatites of the Northeast: diagnosis on the rational and integrated utilization

Adão Benvindo da Luz; Fernando A. Freitas Lins; Bernardo Piquet; Mário Jorge Costa; José Mário Coelho, 2003

SRMI 09 http://www.cetem.gov.br/publicacao/series_srmi/srmi-09.pdf

When it comes to Mining and Pegmatites, there is a consensus in the northeastern region that the usual methods are quite empiric, rudimentary, predatory and have contributed to depreciate the province pegmatite deposits. Therefore, a pilot project is recommended.

The potential of alternative agrominerals in Northeastern Brazil

Marcelo Soares Bezerra, 2010

SRMI 15 http://www.cetem.gov.br/publicacao/series_srmi/srmi-15.pdf

This paper emphasizes the significance of mineral fertilizers for the development of agricultural production presenting the sector's current scenario in Brazil and particularly in the Northeastern region. Alternative mineral inputs to complement the resolution of this problem is also addressed.

6. INNOVATION

Automotive recycling: strategies, practices and perspectives

Heloisa Vasconcelos de Medina, 2003

STA 27 http://www.cetem.gov.br/publicacao/series_sta/sta-27.pdf

Research on automotive materials recycling that has been conducted by the authors, in association with CETEM's research program on Environmental Technologies and Recycling, as a part of a case study on the Materials Recovering and Recycling Project. It explores cars' environmental impacts and new forms of innovation on vehicle production and recycling that are restructuring the automotive industry.

Innovation in materials in the automotive industry

Heloisa Vasconcelos de Medina, 2001

SED 48 http://www.cetem.gov.br/publicacao/series_sed/sed-48.pdf

It presents the case study conducted at Renault, from 1998 to 1999, where it was verified that the diffusion of materials innovation is

compressing the vehicle development cycle and altering the profile and boundaries of all activities involved, such as research and development, design, vehicles engineering and production. It was also observed the parallelism between research and development, viability studies, conceptual design and production. In conclusion, it claims that the new materials introduced in the Renault Clio II confirm the initial hypothesis of the thesis, highlighting the automotive reengineering from the car design to the industrial plant downsizing.

Technological innovation and sectors of extractive mining and mineral transformation

Maria Helena M. Rocha Lima, 2001

SED 49 http://www.cetem.gov.br/publicacao/series_sed/sed-49.pdf

The Brazilian industry aggregate production function is estimated, using panel data, for twenty one industrial sectors and for the 1988-1995 period.

Briquetting and its importance for industry

Walter Shinzel e Regina Célia M. da Silva, 1981

STM 17 http://www.cetem.gov.br/publicacao/series_stm/stm-17.pdf

A review on the various briquetting technologies is presented with an emphasis on the characteristics of the raw, sub and final products of the processes. Practical examples from industrial processes are shown. The utilization of fines can be made easier and more efficient through briquetting.

Attapulgite from Piauí for the pharmaceutical industry

José Pereira Neto, Salvador L. M. de Almeida e Ronaldo de Miranda Carvalho, 1993

STM 64 http://www.cetem.gov.br/publicacao/series_stm/stm-64.pdf

This work aimed at developing a purification process in order to remove the main impurities through physical and chemical operations on attapulgite from Guadalupe, Piauí State, for pharmaceutical purposes.

Zeolites: properties and industrial uses

Adão Benvindo da Luz, 1994

STM 68 http://www.cetem.gov.br/publicacao/series_stm/stm-68.pdf

Synthetic zeolite-based catalysts have been quite used in petroleum refining and in the petrochemical industry and natural zeolites have shown a potential for industrial use in the environmental field.

Fine and ultrafine grinding of industrial minerals: a review

Franz Josef Wellenkamp, 1999

STM 75 http://www.cetem.gov.br/publicacao/series_stm/stm-75.pdf

This work reviews the fundamentals of particle fragmentation and the techniques used for fine and ultrafine grinding of mineral resources for applications in various industrial sectors.

Use of limestone from Cariri (Ceará State) as a mineral aggregate in asphalt pavement

Roberto Carlos da C. Ribeiro, Julio Cesar Guedes Correia, Peter Rudolf Seidl, Jorge Barbosa Soares, Francisco Wilson Holanda Vidal e Lívia Pinheiro de Araujo, 2006

STM 86 http://www.cetem.gov.br/publicacao/series_stm/stm-86.pdf

Cariri, Ceará State, is regarded as an important mineral site due to its rich crystalline and laminated sedimentary limestone reserve. Crystalline limestone is extracted and processed in ovens like kilns, and it is mostly used in the quicklime industry. This work seeked to study another application for this crystalline limestone: as a mineral

7. WASTE AND RECYCLING

Treatment of beach sand contaminated with crude oil using Fenton's reagent

Valéria Souza Millioli, Denize Dias de Carvalho Freire e Magali Christe Cammarota, 2004

STA 31 http://www.cetem.gov.br/publicacao/series_sta/sta-31.pdf

This work aimed at assessing the Fenton´s reagent efficiency on the oxidation and/or removal of crude oil attached to sand particles of soils contaminated by oil spills that took place in Guanabara Bay, January 2000.

Waste of electronic origin

Fábio Henrique Silva dos Santos e Carlos Eduardo Gomes de Souza, 2010

STA 57 http://www.cetem.gov.br/publicacao/series_sta/sta-57.pdf

Electronic waste, "e-garbage", and/or electronic residues, among others, are terms commonly used for electronic appliances when they become obsolete and are consequently discarded. Due to the growing acceleration of that industrial sector, the electronic industry presents a high innovation rate that generates the necessity of replacing those equipments in a shorter period.

Trends in materials recycling in the automobile industry

Flávio de Oliveira Marques e Luiz Antonio de Meirelles, 2006

SED 71 http://www.cetem.gov.br/publicacao/series_sed/sed-71.pdf

This book focuses on the case study conducted in a Brazilian automotive plant and compares the advances on car recyclability promoted by the European Directive and its impacts in Brazil.

Ecoefficiency applied to reduce the generation of solid waste

Cristina Lúcia Silveira Sisinno, Andréa Camardella de Lima Rizzo e Ronaldo Luiz Corrêa dos Santos, 2011

SED 79 http://www.cetem.gov.br/publicacao/series_sed/sed-79.pdf

Ecoefficiency appears as a useful tool to reach this challenge, identifying the economic and environmental aspects related to solid waste generation.

Selective agglomeration of coal fines from Santa Catarina: preliminary studies

Lauro Santos N. da Costa, 1981

STM 16 http://www.cetem.gov.br/publicacao/series_stm/stm-16.pdf

The study was carried out on samples of washed coal and natural fines from Lavadores da Companhia Próspera S.A. Among the main influencing parameters in the selective agglomeration process, the following have been studied: size distribution; different types and concentration of oil; degree of agitation; conditioning time; pH.

Bacterial leaching of low-grade copper in bench scale

Teresinha R. de Andrade e Francisca Pessoa de França, 1984

STM 33 http://www.cetem.gov.br/publicacao/series_stm/stm-33.pdf

The influence of the variation of *Thiobacillus ferro oxidens* initial concentration on bacterial leaching was studied through experiments with low-grade copper sulfide ore. Bacterial leaching proved to be an appropriate technique for the Caraíba low-grade copper ore treatment.

Management of solid waste generators of acid mine drainage using dry covers

Mariluce de Oliveira Ubaldo, Laura de Simone Borma e Maria Claudia Barbosa, 2006

SGPA 04 http://www.cetem.gov.br/publicacao/series_sgpa/sgpa-04.pdf

This work presents a revision of the basic concepts for the study of the mitigation of acid mine drainage through the use of dry cover and it describes the main equations used by the Soil Cover software that can be used for dry cover projects.

Risk analysis applied to tailings management: a review applied to deposits of radioactive waste near the surface

Laís Alencar de Aguiar, Paulo Sérgio Moreira Soares, Paulo Fernando Ferreira Frutuoso e Melo e Antonio Carlos Marques Alvim, 2007

SGPA 09 http://www.cetem.gov.br/publicacao/series_sgpa/sgpa-9_final.pdf

Radioactive wastes result from nuclear energy generation and from the use of radioactive material in the industry, medicine and scientific research. Such wastes emit ionizing radiation and represent potential hazard to the human life and to the environment.

Eco-design for recycling quality of automotive steel and aluminum

Heloisa Vasconcelos de Medina, 2006

SIQ 01 01http://www.cetem.gov.br/publicacao/series_sta/sta-01.pdf

Continuous improvements on materials, metal alloys, metal matrix composites and steel/copper associations in the car are making materials and automotive systems more complex as well as dismantling and recovery, through the recycling of metals found in spare parts and in end-of-life vehicles besides jeopardizing the quality of the recovered material.

Annals of the Seminar on Waste: Technologies and Sustainability
Francisco Rego Chaves Fernandes e Claudio Luiz Schneider (Eds.), 2011
Livro Avulso 09 http://www.cetem.gov.br/publicacao/livros/residuos_tecnologias_sustentabilidade02.pdf

The publication of these Annals is the result of the homonymous seminar which took place on June 13, 2011 at CETEM. The event also featured technical papers presented by CETEM's researchers, technologists and scholars. The propagation of the book's subject matter demonstrates the Center's commitment to environmental issues concerning the problem of wastes from mineral resources, in agreement with Law No. 12305 that establishes the National Policy on Solid Waste.

Texto composto em Trade Gothic, corpo 10/13.5.
Impresso em junho de 2012
na Singular Gráfica e Editora Ltda.

Da Rio 92_ingles.indd 70 6/6/12 4:03 PM

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