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Sustainability, ecoefficiency, circular economy in mining industry and eu raw materials strategy frame work

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SYNOPSIS

Mining has been the cornerstone of human civilization and has been contributing to local, national and international economies. The flow of raw materials is crucial for sustainable development. However, in part of the world it has been characterized by inappropriate planning, operational and post-operational practices which resulted in significant adverse environmental, safety and inefficiency impacts. Around the world, sustainability, ecoefficiency and circular economy concepts are proposed and implemented in mining industry to not only justify the future needs for raw materials but to protect the environment through resource efficiency and reducing its environmental footprints. Herein, sustainability, ecoefficiency with respect to circular economy are brought into consideration and the EU strategy to secure sustainable supply of the raw materials is presented.

MINING AND SUSTAINABILITY

The market values for mining and energy sectors worldwide were respectively at US$ 1trillion and US$ 1.3 trillion in 2015 (Sustainability in the Mineral and Energy Sectors 2016). As these two sectors are vital to many world economics, the stability issues facing these sectors assume greater significance. However, the high dependency of the mining industry to the energy revealed the needs for investment to innovate and develop methods and practices in bold sustainability.

Mining is an energy intensive industry, consuming 6-7% of world's energy, from which, almost half goes for comminution/size reduction, i.e., crushing and grinding. Furthermore, one must add additional "embodied energy" to manufacture steel as the media consumption in comminution which amounts up to 4-6 kWh/ton of comminuted raw material.

Furthermore, the industry consumes considerable amount of water which is estimated at the range 6-8 billion m^3 per annum, approximately 0.5 to 1 m^3 of water per ton of ore processed material by flotation. Additionally, the environmental issues regarding process water contaminations and its release to environment as well as the costs for water treatment must be realized.

Ever increasing global demand for consumer goods indicate the extraction of raw materials is expected to increase. That represents a significant opportunity for the mining sector for future development. Meeting the demands for raw materials is vital for mining industry since there are issues ranging from declining global reserves, complexity of the ongoing and future projects, increasing government invention, and changing requirements from key stakeholders around environmental and social issues. For mining industry, except profitability, there are some crucial factors that represent components in economic machinery of a mine and related activities. These are sustainability and

minimizing the environmental impacts. In a border sense, sustainability aimed at improving the quality of life for everyone, for now and generations to come. The concept integrates economic, environmental and social considerations to have adequate resources and opportunities for development. Although, sustainability in mining industry is not a new approach, inevitably, it is construed as a paradox. The growing global mineral demand driven by population explosion and the aspirations of society for an ever-improving living standard have seriously impacted the ability of the industry to cope with sustainability.

During the last few decades mining has been prominently involved in the global debate of sustainability; however, sustainability within the industry is not a simple concept:

- Production gradually or exponentially increases, leading to giant mining activities where the ore grades are gradually declined.
- Open cut mining, which is now widespread and likely to be sustained in near future, however, new mineral deposits are likely to be deeper, therefore, deep underground mining like block caving emerge at higher cost.
- Waste rock/overburden increases rapidly and that is likely to continue in the future at it is closely linked to open cut mining.
- Economic resources commonly increasing but some remain stable or gradually declining. The future is closely linked to exploration, technology, and economic developments.
- Energy consumption per ton and related carbon footprint increase, concerning economical, environmental.

MEASURING SUSTAINABILITY

- Inevitably, mining industry plays a vital role in human being life for development
- There are some elements to measure and define sustainability which are:
- The contribution to the regional, and global economy
- Health, safety of the working environment
- Water and energy consumption, conservation and related carbon footprint
- Resource efficiency and recovery rate
- Availability and reliability for machineries,
- Investment in R&D and new technologies and adaptability to accept and implement of those technologies.

ECO-EFFICIENCY AND MINING INDUSTRY

Since ancient time, mining industry has been strongly contributing to social and economic development and has great impact on social, economic and environmental aspects of Mankind. In 1992, eco-efficiency was defined by the World Business Council for Sustainable Development (WBCSD) as providing competitively priced goods and services, satisfying human needs and improving life quality while reducing environmental impact and use of natural resources through the goods life cycle. In 2012, the method for eco-efficiency was standardized to assess all aspects in quality and quantity of the products. Accordingly, eco-efficiency is an indicator of innovativeness, and on its basis, determines how a technology, product, or services affects the environment and economic aspects of the society and compare its efficiency with other technologies, products or services enabling choosing a solution to bring maximal benefits at the lowest potential cost and environmental competence/efficacy. Hence, the eco-efficiency aimed at:

- Reduce use of resources, particularly, energy, water, and land
- Reduce negative impact on environment (reducing dust, GHG, waste, swage and toxics)
- Increasing in the value added (quality, e.g., increasing recovery and grade, as well as improving functionality, durability, and flexibility)
- Increasing economic efficiency, etc.,

Through a circular economy approach for development, the eco-efficiency in mining industry has to be improved mainly by reduction in energy and water consumption per ton of product, reducing dust and GHG emissions, renewability, process flexibility and integrity, reducing production loss and downtime in production, wastes reduction and removal, as well as reuse and recycling (Fig.1).

From macro level the mining industry provides

the foundation for the nation to transition from mining based industry to more comprehensive and diverse set of industries such as services, tourism and agriculture, or fully transitioning to a low carbon economy. From micro level, the communities are created or enhanced within the vicinity of a mine. However, from macro level the mining.

EU RAW MATERIALS FRAMEWORK AND RAW MATERIALS INITIATIVE

To secure sustainable supplies in developing policy and improve resource efficiency, EU initiated a comprehensive program on raw materials based on three main pillars, i.e., fostering sustainable supply from EU resources, boosting resource efficiency and recycling, and ensuring level playing field in access to resource in third countries. To prompt and achieve the goals a comprehensive program called "EIT- KIC Raw Material (European Innovative and Technology – Knowledge and Innovative Community on Raw Materials)" was initiated to cluster mining, metallurgy and machinery manufacturing companies, universities, engineering houses and other research and development groups as well as entrepreneurs through a challenge driven approach for the entire value chain of raw materials (i.e., exploration, exploitation, processing, using, recycling, substitution, etc. The main objectives through KI-Raw Materials program are to reduce import dependency, improve supply conditions, provide alternatives in supply, mitigate negative environment and social impacts, and pushing Europe to the forefront in raw materials sectors.

The initiatives are created based on technology, non-technology, and international cooperation pillars. Part of the program is strategically moving towards decarbonization energy pathway and fostering the sustainability and competitiveness in reducing greenhouse gas emissions by 2050 to 85-95% below the 1990 levels by using strategic/ critical raw materials.

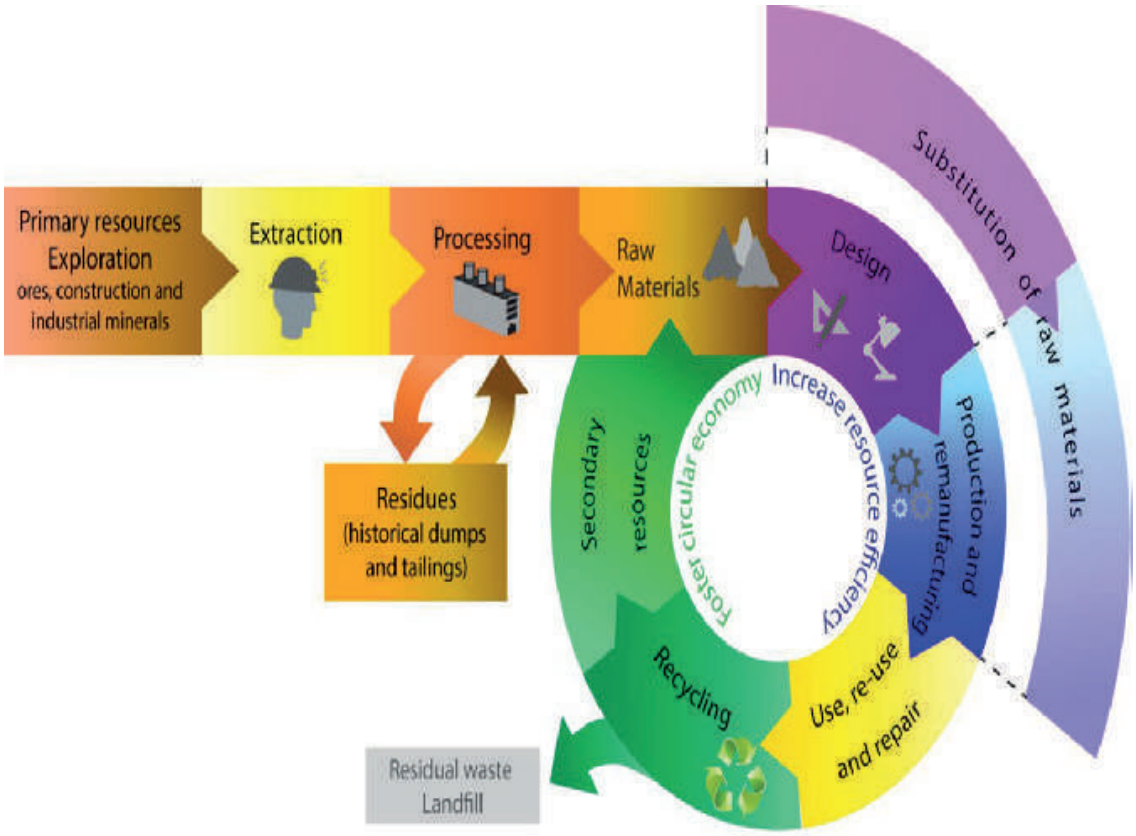

Fig.1- Circular Economy for Sustainability and Ecoefficiency within the Mining and Production Chain