Global Challenges, Policy Framework & Sustainable Development for Mining of Mineral and Fossil Energy Resources (GCPF2015)

Environmental Aspects and Impacts its Mitigation Measures of Corporate Coal Mining

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Abstract

Coal mining, the first step in the filthy lifecycle of coal causes deforestation and releases toxic amounts of minerals and heavy metals into the soil and water environment. Coal mining’s environmental effects persist for years after coal is removed. Based on the latest technologies on coal mining practices are better than what was done earlier days. At the same time bad mining practices can ignite coal fires which can burn for decades, release fly ash and smoke laden with greenhouse gases and toxic chemicals. Furthermore mining releases coal mine methane, a greenhouse gas 20 times more powerful than carbon dioxide. Corporate Coal mining importantly surface mining requires huge areas of land to be temporarily disturbed. This raises a number of environmental challenges, including soil erosion, fugitive dust, noise and water pollution and impacts on local biodiversity. Steps are to be taken in modern mining operations to minimize impacts on all aspects of the environment. By carefully pre-planning projects, implementing pollution control measures, monitoring the effects of mining and rehabilitating mined areas, the coal industry minimizes the impact of its activities on the neighbouring community, the immediate environment and on long-term land capability. Coal dust inhalation causes black lung disease among miners to those who live nearby and mine accidents kill thousands every year. Coal mining displaces whole communities, forced off their land by expanding mines, coal fires & subsidence and contaminates water supplies from the mining areas.

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1. Global coal industry and reserves

The coal deposits although exist in nearly every region, commercially exploitable deposits occur in Europe, Asia, North America and Australia. The global coal resource was estimated to be 847 billion tonnes (source: World Coal Association). 860 billion tonnes (Source: Wikipedia) by end of 2010. The USA had the largest share of the global resource (25.4%) followed by Russia (15.9%) and China (11.6%). India was 4th in the list with 8.6%. / (7% source: Wikipedia).
In the work power generation scenario 41% is used as coal fuel and 81% of the production from thermal power station in the world power market.

1.1. Basic two types of mining activities

Strip Mining: Strip mining is also known as open cast, mountaintop or surface mining involves scraping away earth and rocks to get to coal buried near the surface. In many cases, mountains are literally blasted apart to reach thin coal seams within which results in leaving permanent scars on the landscape.

![Fig. 1. Strip mining](image)

Strip mining accounts for about 40 percent of the world’s coal mines but in some countries, such as Australia, open cast mines make up 80 percent of mines. Even though it's highly destructive, industry often prefers strip mining as it requires less labour and yields more coal than underground mining.

1.2. Environment impacts & aspects of strip mining

- Strip mining destroys landscapes, forests and wildlife habitats at the site of the mine when trees, plants, and topsoil are cleared from the mining area. This in turn leads to soil erosion and destruction of agricultural land.
- When rain washes the loosened top soil into streams, sediments pollute waterways. This can hurt fish and smother plant life downstream and cause disfiguration of river channels and streams which leads to flooding.
- There is an increased risk of chemical contamination of ground water when minerals in upturned earth seep into the water table and watersheds are destroyed when disfigured land loses the water it once held.
- Strip mining causes dust and noise pollution when top soil is disrupted with heavy machinery and coal dust is created in mines.

The result of all this is barren land that stays contaminated long after a coal mine shuts down.

Although many countries require reclamation plans for coal mining sites, undoing all the environmental damages to water supplies, destroyed habitats and poor air quality is a long and problematic task. This land disturbance is on a vast scale. In the US, between 1930 and 2000, coal mining altered about 2.4 million hectares (5.9 million acres) of natural landscape, most of it originally forest. Attempts to re-seed land destroyed by coal mining is difficult because the mining process has so thoroughly damaged the soil.

According to a 2004 estimate, coal mining in China has degraded the quality of land of an estimated 3.2 million hectares. The overall restoration rate (the ratio of reclaimed land area to the total degraded land area) of mine wasteland was only about 10–12 percent.
1.3. Underground mining

The majority of the world’s coal is obtained through underground mines which allow coal companies to extract deeper deposits of coal and is viewed as less destructive than strip mining. It still causes widespread damage to the environment. In room-and-pillar mines, columns of coal are left to support the ground above during the initial mining process. Then they are often taken out and the mine is left to collapse which is known as subsidence.

In long wall mines, mechanical shearsers strip the coal from the mines. Support structures that enable the shearsers’ access to the mine are eventually removed and the mine collapses.

1.3.1. Impacts of underground mining

Underground mining causes huge amounts of waste earth and rock to be brought to the surface – waste that often becomes toxic when it comes into contact with air and water.

- It causes subsidence as mines collapse and the land above it starts to sink. This causes serious damage to buildings.
- It lowers the water table changing the flow of groundwater and streams. In Germany for example, over 500 million cubic meters of water are pumped out of the ground every year. Only a small percentage of this is used by industry or local towns – the rest is wasted. What’s worse is that removing so much water creates a kind of funnel that drains water from an area much larger than the immediate coal-mining environment.
- Coal mining produces also greenhouse gas emissions.

2. Methane generation in coal mines and its global environment concern

Coal mine methane, less prevalent in the atmosphere than CO2 but 20 times as powerful as a greenhouse gas, forms during the geological formation of coal is released during the coal mining process. Most coal mine methane come from underground mines. While this methane is often captured and used as town fuel, industrial fuel, chemical feedstock and vehicle fuel, it’s very rare that it all gets used.[vii] Methane is also used in power generation projects. However, despite big investment in research only about 50 such projects exist worldwide. China which mines more than 95 percent of its coal underground about 300 of the state-owned mines are classified as methane-outburst prone. Worldwide emissions are expected to increase by 20 percent in the next 12 years.

3. Smoldering of coal stack yards and waste piles

Coal fires - burning or smoldering coal seams, coal storage piles or coal waste piles – are a significant environmental problem in many countries, including China, Russia, the US, Indonesia, Australia and South Africa. Underground coal fires can burn for centuries, filling the atmosphere with smoke laden with carbon-monoxide (CO), carbon-dioxide (CO2), methane (CH4), sulphur dioxide (SO2), nitrous
oxides (NOx) and other greenhouse or toxic gases - as well as fly ash from vents and fissures. Other effects of coal fires include rising surface temperatures and contamination of groundwater, soil and air environment especially.

Although coal fires can be caused by thunderstorm lightning, and forest or peat fires, they are often caused by mining accidents and improper mining techniques. In Indonesia, the same fires that are used to clear large tracts of rainforest have ignited over 300 coal fires since the 1980s. China has the world’s most coal fires while India accounts for the world’s greatest concentration. In China, between 15 and 20 million tons of coal burn uncontrollably each year accounting between 0.1 percent and 1 percent of the world’s human-induced CO2 emissions.

4. Acid mine drainage

Acid mine drainage is created when water mixes with coal and other rocks unearthed during mining taking on toxic levels of minerals and heavy metals. This toxic water leaks out of abandoned mines to contaminate groundwater, streams, soil, plants, animals and humans. As a result an orange colour can blanket the river, estuary or sea bed killing plants and making surface water unusable as drinking water. Sources of acid mine drainage can remain active for decades or centuries after a mine closes.

5. Waste disposal

The total amount of coal combustion wastes produced is staggering: In the United States alone about 130 million tons of coal combustion waste products are produced every year. Most coal power waste winds up in landfills, surface impoundments or in mines whereas smaller amounts are used for e.g. cement or thermal power production.

Typically, solid waste is stored in landfills while liquid waste is stored in impoundments. Ideally these disposal sites should be designed to prevent the toxic wastes from entering the environment. But a recent US industry survey of disposal units revealed that this is not the case. About 40 percent of the coal waste landfills and 80 percent of the coal waste surface impoundments in the US lack liners.

6. Effects on human health

Toxic levels of arsenic, cadmium, chromium and lead can be found in coal-fueled power plant waste. If these contaminants enter the environment - through dust, leaching into groundwater or from discharges into surface waters - they can contaminate drinking water supplies and accumulate in livestock and crops. Arsenic has been associated with cancer and cardiovascular and neurological damage. Cadmium has been linked to kidney damage plus risks of prostate and respiratory cancer.

Lead is extremely dangerous for children and has been linked to developmental delay, hypertension, impaired hearing acuity, impaired hemoglobin synthesis and male reproductive impairment. The USEPA Environment Protection Agency found that the average health risks to the public due to metals from power plant waste disposal units could be up to 10,000 times higher than their allowable risk levels for cancer and other illnesses.

Coal causes climate change: Coal burning is responsible for one-third of all our carbon dioxide pollution (CO2). It is the most polluting way to generate electricity accounting for over 70 percent of the CO2 emissions from the power sector. CO2 is the most prevalent of the greenhouse gases (GHGs) fuelling the greatest environmental, humanitarian and economic threat, the world has ever faced. According to the mining experts study the potential cost of dealing with the climate change caused by this CO2 will be up to 20 percent of the world’s GDP by 2100. Avoiding climate changes worst impacts means halting the growth in CO2 emissions by 2015 and then reducing the emissions radically thereafter.

7. Common health and environmental threats posed by coal mining

- Pneumoconiosis, aka black lung disease or CWP (Coal Washing Points) is caused when miners breathe in coal dust and carbon which harden the lungs. Estimates show that 1,200 people in the US still die from black lung disease annually. The situation in developing countries is even worse.
- Cardiopulmonary disease, chronic obstructive pulmonary disease, hypertension, lung disease, and kidney disease have been found in higher-than-normal rates among residents who live near coal mines, according to a 2001 study.
Toxic levels of arsenic, fluorine, mercury and selenium are emitted by coal fires entering the air and the food chain of those living nearby.

Mine collapses and accidents kill thousands of workers around the world every year. Chinese coal mine accidents killed 4,700 people in 2006.

Coal is the single biggest source of climate changing CO2 pollution.

Coal mining destroys ecosystems releases toxic levels of minerals and gasses into our water and air (including the potent greenhouse gas methane) expose miners and those who live nearby to coal dust and other toxins. Thousands of people die in mine collapses around the world every year.

Beside CO2, coal combustion releases millions of tons of sulphur dioxide and nitrogen oxides into the air which create acid rain and smog.

Coal burning also yields particulate matter pollution which creates air pollution and respiratory ailments, among other health problems.

Another by-product of burning coal is mercury which infiltrates the food chain and attacks the human nervous system. Young children and babies whose nervous systems are still developing are especially vulnerable.

Burning coal creates millions of tonnes of waste products that contain toxic levels of heavy metals and minerals. These mostly end up in landfill sites or impoundments and pose a threat to our health and environment.

The world doesn't need more coal, it needs an energy revolution. We have enough technically accessible renewable energy to meet current energy demands six times over. Our Energy Revolution blueprint shows how renewable energy combined with greater energy efficiency can cut global CO2 emissions by almost 50 percent and deliver half the world's energy needs by 2050.

Produced in conjunction with the independent Dutch Institute CE Delft, the report puts a price tag on some of the damages caused by producing and burning coal including climate change, health impacts from air pollution and loss of life from mining accidents. In 2007 these damages cost the world at least INR 27773 billion.

Table 1. Mitigation of occupational health and safety issues

| Activity            | Mitigation measures                                                                 |
|---------------------|-------------------------------------------------------------------------------------|
| Drilling and blasting | Driller shall be equipped with a closed cabin to reduce exposure to noise and dust. In addition, the operators and other workers should be provided with masks, helmets, gloves and earplugs. |
| Safety zone          | Provisions should be made for a buffer zone between the local habitation and the mine lease in the form of a green belt of suitable depth. Restricted entry, use of sirens and cordoning of the blasting area are some of the good practices to avoid accidents. |
| Workers health surveillance | Health survey programs for workers and local community. Regular training and awareness of employees to be conducted to meet health and safety objectives. |
| Mine inundation      | Mine inundation may lead to a serious disaster if a river is flowing close to the mine pit. Hence a buffer space of a suitable width should be maintained which should be followed by construction of embankments after considering high flood level. In underground mines, if the shaft is located in a low lying area or is vulnerable to flood risk, garland drains should be provided around the shaft. |
| Mine fires           | Try to extinguish the new fires and try to isolate existing fires. Try to take a scientific approach to mining practices and give due consideration to proposed fire prevention plans. Carry out monitoring using new scientific techniques. Risk of explosions in underground mines can be managed by good mine planning, methane gas monitoring, good ventilation and controlling dust levels. |

8. Conclusions

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