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Tech 393

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Term Paper

Rare Earth Metals: China's Growing Environmental Crisis

In today's society, technology[1] is becoming a dominant factor in the growth of economies, the improvement of living standards, and the answer to pollution in the industrialized worlds[2]. Often we view technology as the answer to all of our problems; however, we often do not contemplate the consequences of the implications of technology. While dwindling economies and vast pollution posse to threaten our way of life, our reliance on technologies to solve these problems may be contributing to the problem at hand.

The majority of modern technologies rely on rare earth metals[3]. Rare earth metals are the fifteen lanthanides[4] plus scandium and yttrium. While these elements are relatively abundant in the Earths crust[5], there are no abundant caches of these metals, making mining these metals very expensive and un-cost effective. Whatever the cost, these minerals are used in every modern technology today. They are used in everything from computers, cellphones, and tablets, to drones, fighter-jets, and guided missiles. "China produces 85% of global supply of the 17 chemically similar elements crucial to smartphone, camera lens and magnet manufacture – and half that output is from the city of Baotou"(The Guardian, 1). While rare earth metals

have allowed for economic growth in China, they have also lead to vast environmental damage to China's rivers, farmland, and drinking water.

The mining process[6] of rare earth metals leaves radioactive bi-products that are washed into large tailing ponds that have been made to collect this radioactive material. "In Inner Mongolia, the state-run Baogang Group's Weikuangba tailing pond is the largest in the world and holds over 230 million cubic meters of deadly waste"(Kilby, 543). As the need for these rare earth metals increases new tailing ponds[7] will be created and old ones will continue to become larger. It is estimated that the Baogang Groups[8] adds 7 million cubic tons of liquid waste a year to this tailing pond. "The radioactive content of mined minerals may be low, but evaporation concentrates this waste to dangerous levels"(Lilby, 543). As demand rises for these metals the concentration of radioactive materials will increase exponentially.

With several cities in China recording radiation levels above China's national standard, these radioactive tailing ponds posse a great threat to both the residence of the area and the farmland that they live on. "Researchers at the Chinese Centre for Disease Control and Prevention have conclusively linked thorium dust exposure to increase cancer and mortality rates in rare earth miners and workshop workers. Studies have also found that many rare earth communities are exposed to radiation levels that often exceed national standards"(Kilby, 543). Communities all across China have been stricken with disease and cancer. Their farmland withers and dies and their health deteriorate. Some of these communities have become so poor that they simply turn their diseased farmland into rare earth mines[9] in order to make

enough money to live. These illegal mines are unregulated and dispose of their waste as they please.

Chinese citizens that live near large tailing ponds like the one near the Yellow River[10] have reported that,

> "In the beginning, there was no tap water here, so we all drank from wells," Wang said. "The water looked fine, but it smelled really bad." In the 1990s, when China's rare earths production kicked into full gear, his sheep died and his cabbage crops withered. Most of his neighbors have moved away. Seven have died of cancer. His teeth have grown yellow and crooked; they jut out at strange angles from blackened gums"(The Guardian, 3).

The radioactivity of their land has grown so bad that citizens can witness as their crops die and their bodies mutate.

Though tailing ponds have been set up and lined as to prevent the spread of their radioactive waste into their environment, some of the largest ones were found improperly constructed with their linings leaking radioactive waste. "The pond, owned by the Inner Mongolia Baotou Steel Rare-Earth Hi-Tech Company, or Baotou Steel, lacks a proper lining and for the past 20 years its toxic contents have been seeping into groundwater, according to villagers and state media reports. It is trickling towards the nearby Yellow River, a major drinking water source for much of northern China; at a rate of 20 to 30 meters a year"(The Guardian, 2) Only recently has the rare earth mining industry come under scrutiny.[11] These practices have existed for 50 years and the largest operations have been threatening China's environment for decades. When the radioactive waste finally reaches the Yellow

River that will be the end of clean drinking water for most of northern China.

Even adequately constructed tailing ponds do not properly contain the material waste in which they are built to contain. As the demand for rare earths metals grow, we produce more waste than the tailing ponds can hold and become prone to overflowing. "Engineers have warned that the bottom of the tailing pond is not properly lined and is leaking into the groundwater. Additionally, eyewitness accounts in the China Daily report that the reservoir regularly overflows into the Huanghe during the rainy season, causing radioactive waste to seep into Baotou's farmland and run off back into the river"(Kilby, 544). Our current manor of industrial processing[12] of rare earth metals posses a great threat to the environment and our personal health. As our demand on technology will likely never cease, it is prudent we address the amount of toxic waste our technological needs produce.

All of our current technology relies heavily on rare earth metals[13]. We can process several tons of rare earths a day simply building computers and smartphones; however, processing just one ton of rare earth produces 2000 tons of toxic waste. Technology's reliance on these materials, combine with our current mining practices, has lead to environmental and sociological[14] hazards across China. "The reality is that, as Britain flaunts its environmental credentials by speckling its coastlines and unspoiled moors and mountains with thousands of wind turbines, it is contributing to a vast man-made lake of poison in northern China. This is the deadly and sinister side of the massively profitable rare- earths industry that the 'green' companies profiting from the demand for wind turbines would prefer you knew nothing about"(Perry, 2) As our processing of these materials grows so will

the pollution and only recently has the World Trade Organization[15] called these practices into question. The amount of pollution this industry creates has already threatened major cities, farmlands, and major fresh water sources.

In hindsight, the rare earth industry has made efforts to correct this industrial disaster by relocating the citizens that live in the area; however, the damage has already been done. Acid lakes sprawl for kilometers and are a reminder of the effects technology can have on our environment. "In 2009, Baotou Steel began relocating farmers from villages around the tailings pond to resettlement sites on the city's outskirts; it has set up a waste managing warehouse staffed by 400 employees. Yet the pond is still a reminder of how far China's cleanup effort has to go. Surrounding villages are decimated. Stray dogs amble through desiccated corn and wheat fields, the rusted frames of dismantled greenhouses arching above tangles of discarded plastic bags"(The Guardian, 5). These acid lakes only become more radioactively concentrated as evaporation and overflow continue to remove H20 leaving pools of concentrated radioactive sludge.

Another of the major problems is the industry itself and poverty stricken farmers who are reduced to rare earth mining. As more and more cropland becomes unusable, people leave and search for other means of making a living. Those that do not turn their farms into rare earth mines will often go work for the companies that mine the rare earth metals[16]. These workers are not thinking about environmental impacts they are simply trying to find work. "When asked about the plant's environmental impact, he shrugged his shoulders. 'We don't understand these things,' he said. 'We're just here to make a living' "(The Guardian, 11). This is a

problem of industry and society; because, as it encroaches on the lives of those around it the rare earth industry becomes the only means of survival for these lost farmers. If they were to give up rare earth farming it would be on the state to care for them, which brings additional burden on the society as a whole. Poverty stricken social groups[17] will generally ignore environmental consequence in order to improve one's living situation.

China has acknowledged the problem in front of the World Trade Organization and claims that it's current standard of setting quotes for producers of rare earth metals is in line with the current regulations. "China's position was that it's export quotas and duties were consistent with articles to GETT 1994, namely: XI: 2(a), which is designed to prevent a critical materials shortage; XX (g), which ensures the conservation of an exhaustible natural resource; and XX9 (b), which allows for environmental protection measures"(Kilby, 542). While quotas[18] set limits for large companies it essentially encourages growth in private rare earth mining, which is largely unregulated by any governing body. Quotas also encourage large mining operations to focus on mining only the most valuable of rare earths and discarding un-valuable materials.

Quotas are an ineffective answer to a culminating crisis that needs serious delegation and regulation. The current system only encourages the poor farmers to tern their farm land into mines, because a quota market will only drive up prices and prohibit large industries from over mining. "China's policies provide substantial competitive advantages for downstream Chinese industries at the expense of non-Chinese users of these material"(Kilby, 542) Though these policies have been

brought to question in front of the WTO[19], no official action has been taken to force China to get this problem under control. While all current regulations are complied with, no actions have been taken to control the increase in mining and some say China encourages its private market[20] to pick up the slack in the mining industry.

In conclusion the rare earth industry is a perfect example of the un-intended effects technology has on our society and our environment. We often over look the large scale and long-term effects that technology has on our environment, which inevitably will lead us to some sort of environmental or economic cataclysm. Unchecked the continued production of rare earth metals could wipe out both farmland and drink water across China. The devastating loss of farmland and drinkable water is only the tip of the iceberg as these rare earth mines and tailing pond have brought sickness and physical deformity to residents of nearby villages. Should rare earth metals continued to be mined under their current regulations then scientist predict this could lead to cataclysmic environmental damage within the next 20 years.

While the United States of America, the U.K., and other countries have all brought this ever-rising problem to the attention of the World Trade Organization, China shows no signs of slowing up its production or changing its mining habits. The United States, however, is looking into new methods of mining, as well as, encouraging the use of recycled rare earth metals. It will take a combination of both the industries lessening its demand on these minerals and world government's regulation the process by which these minerals are mined, before we see this problem resolve itself.

Notes

1: Technology: machinery and equipment developed from the application of scientific knowledge.

2: industrialized worlds are those that use factories and factors of mass production. A system of industries

3: Rare Earth Metals: Scandium, Yttrium, Lanthanum, Cerium, Praseodymium, Neodymium, Promethium, Samarium, Europium, Gadolinium, Terbium, Dysprosium, Holmium, Erbium, Thulium, Ytterbium, Lutetium.

4: The lanthanide series of chemical elements comprises the fifteen metallic chemical elements with atomic numbers 57 through 71, from lanthanum through lutetium.

5: The thinnest layer of earths crust. It averages about 25 miles in thickness at its thickest point.

6: Rare Earth Mining Process – A whole is dug in the earths crust; The whole is filled with chemicals; After a few weeks the chemicals are washed out of the whole; Only the Rare Earth Metals are left.

7: Tailing Pond: A large pond lined in rubber used for catching radioactive waste

8: Baogang groups – Established in 1954 they are one of the Worlds top producers of Rare Earth Metals.

9: Rare Earth Mines – Usually large chemical plants accompanied by a tailing pond (acid lake) for collecting radioactive waste; however, these mines can be as small as a couple acres of farm land and can be run by farmers using household chemicals.

10: Yellow River - Third largest river in Asia

11: 2008 was the first time this problem was brought in front of the World Trade Organization

12: Currently there are no other ways to mine these metals; however, the United States has been researching cleaner methods.

13: Modern technologies rely on high-powered magnets, which only exist as a limited resource in rare earth metals.

14: As economic growth becomes peoples only focus we see this problem move from being an ecological problem to a sociological problem.

15: World Trade Organization - The World Trade Organization (WTO) is the only global international organization dealing with the rules of trade between nations.

16: The mining industry has become the only option for farmers who have lost their farmland.

17: Poverty Stricken Social Groups: Those in poverty are often only concerned with survival, and as farming is replaced by mining, we see the poverty stricken social groups move to mining as their only option.

18: Quotas - a limited or fixed number or amount of people or things, in particular.

19: WTO – World Trade Organization

20: Private Rare Earth Mining Market – this is mostly comprised of illegal mining pits, usually made by poverty stricken farmers, and do not use tailing ponds to collect their radioactive waste.

Resources

Kilby, Charles. "China's Rare Earth Trade: Health and the Environment." *China Quarterly* 218 (2014): 540-50. Web.

Perry, Simon. "In China, the true cost of Britain's clean, green wind power experiment: Pollution on a disastrous scale." *Mailonline*. Web. 3 Dec. 2014.

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