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PROBLEMS OF BATTERY PRODUCTION AND RECYCLING

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Electric cars and renewable energy sources are becoming more popular which is creating a huge demand for electric batteries. Batteries have become essential for automobiles, mobile devices, stationary energy sources, and other battery powered systems. However, meeting the demand for batteries poses serious social and environmental challenges. These challenges start from raw material extraction all the way to disposal of the batteries, which causes an even greater need for sustainability and environmental protection.

There are many components and different stages when it comes to production of batteries. In the first stage, electrodes are created alongside anode which is composed of copper foil with graphite and a cathode which is made from aluminum foil coated with active materials like NMC (nickel manganese cobalt) and NCA (nickel cobalt aluminum). These materials are suspended within the metal foil before being coated and subsequently dried. In the next stage, the separator casing is added to the anode and cathode to avoid contact with each other, after which an electrolyte is added for ionic conductivity. The casing is then locked to ensure structural integrity. Finally, the batteries are charged, discharged and tested to determine their functionality.

Producing batteries is undeniably a complex business. The primary challenge stems from the growing dependence on sparkling fuels and nickel, cobalt, or lithium rich materials due to their limited availability. Growing demand to procure these materials often comes at a cost of severing the ecosystem, increasing pollution together with the carbon footprint, and squandering water resources. To illustrate, nearly two million liters of water is needed to pull out a single ton of lithium. Subsequently, the dangerously high industry grade standards along with quality requirements make efficiency and safety dangerously unachievable. Manu-

facturing deviation no matter how slight in nature will always result in operational overheating which sets the primary source of uncontrolled fires or explosions. All these obstacles show the superior need to transform technologies to address social and environmental impacts by using efficient alternatives.

There are serious issues with supplying waste from batteries and their disposal. Rising consumption levels correlate with increasing the number of batteries which contain toxic components. During the breakdown and slicing processes of the two most important elements, lithium and cobalt, toxic elements get released, such as heavy metals (lead, cadmium, and mercury) plus electrolyte components, which ends up contaminating the ground, soil, and even air. If not treated clean or properly disposed of, these chemicals pose an immense danger to human beings and the environmental system. Just like everything else, there are difficulties met from classification of the waste batteries with the distinct varieties of their designs. The structures of different brands and types of batteries are not the same and their chemical makeup is so different, making it even harder for them to be recycled and requiring a lot of expensive and complicated machines.

Recycling is mainly focused on two kinds of technologies: pyrometallurgy and hydrometallurgy. Hydrometallurgy refers to using chemical reagents such as acids to dissolve metals, allowing lithium, cobalt, and nickel to be extracted. Aggressive chemical reagents used in hydrometallurgical processes lead to the formation of toxic waste and polluted water.

The method of pyrometallurgy is more effective, but it requires high temperatures which leads to increased energy consumption and carbon monoxide emissions, which worsens climate change. Furthermore, another barrier is the collection and sorting of old batteries since different types of batteries require different methods of disposal.

The difficulties and risks listed above require operational research in this area aimed to solve the existing problems of battery production and recycling.

References

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