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Potentials of Lithium for The Industrial Development of Electric Vehicles Sector in Nigeria

ONWUGHALU, M.K[1], OGWATA, C M[2]
[1, 2]Department of Electrical/Electronic Engineering Technology, Federal polytechnic Oko, Anambra State

Abstract- The electric vehicle industry has grown exponentially in recent years, due to the global attention to renewable and alternative sources of energy. It is estimated that Nigeria has over 100 million tons of lithium ore deposit and it is an important component in the production of battery for Electric Vehicles. The prospect of Lithium in global economy is promising, so the automotive industry which is witnessing growth , creates more demands for the raw material. This paper seeks to highlight the potentials of Lithium as a material for sustainable industrial development of electric Vehicle sector in Nigeria.

I. INTRODUCTION

Lithium-ion batteries are currently used in most portable consumer electronics such as cell phones and laptops because of their high energy per unit mass relative to other electrical energy storage systems. They also have a high power-to-weight ratio, high energy efficiency, good high-temperature performance, and low self-discharge. Most components of lithium-ion batteries can be recycled, but the cost of material recovery remains a challenge for the industry (Thomas, 2020).

Electric vehicles have attracted widespread interest because of their ability to reduce energy consumption and emissions. Governments and manufacturers continue to make new commitments for electric vehicle sales, and the cost of manufacturing electric vehicles continues to fall, making them more competitive with internal combustion vehicles. Advances in lithium-ion battery technologies have been key to the growing success of electric vehicles, and a continued transition to electric drive will necessitate far greater battery production.

II. THE PROJECTION OF ELECTRIC CAR

The electrification of personal mobility is picking up speed in a way that even its most ardent proponents might not have dreamt of just a few years ago. In many countries, government mandates will accelerate change. But even without new policies or regulations, half of global passenger-vehicle sales in 2035 will be electric as illustrated in figure 1.

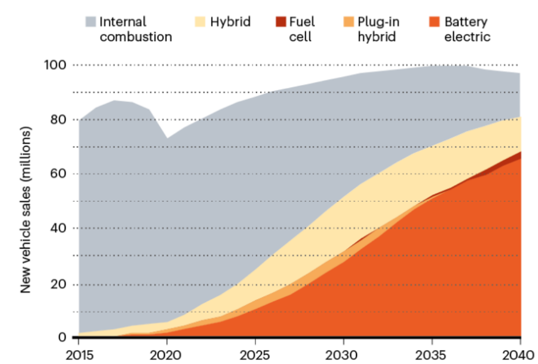

Fig 1. Growth forecasts of electric vehicle sales (BNEF, 2021)

This massive industrial conversion marks a "shift from a fuel-intensive to a material-intensive energy system", declared the International Energy Agency (IEA). In the coming decades, hundreds of millions of vehicles will hit the roads, carrying massive batteries inside them, each of those batteries will contain tens of kilograms of materials that have yet to be mined (IEA, 2021).

III. SOURCES OF LITHIUM FOR BATTERY PRODUCTION

Lithium which is derived from a Greek word meaning "stone" is a very soft, silvery-white metal that smokes and sizzles if water is poured upon it. Lithium is so light that a bar of it will float on water. It also has a melting point and the highest heat capacity of any element. Hence, it is used as a coolant in some nuclear reactors and also in the production of batteries, lubricants, industrial dryers, air-conditioners, glass, medicines, and nuclear bombs (Eleanya, 2021).

According to Baars, J., Domenech, T., Bleischwitz,(2021), There is enough metal in the crust to support the battery industry globally, To manufacture an EV battery, lithium and other minerals such cobalt, nickel as well as other rare earth metals are required. Lithium ore, which is one of the most important raw material is found in large quantities in Nigerian states such as Kogi, Nasarawa, Ekiti, Kwara, Cross River, Oyo, Plateau, and a few other states (Ichu, 2020)

IV. LITHIUM BATTERY TECHNOLOGY

The battery packs on electric vehicles are built from thousands of cells, with electronics to manage charging and discharging. Battery packs typically contain substantial amounts of steel, aluminum, copper, and polymers in addition to the electronics components in the cells. To prevent overheating, some units include an active cooling system. Since a battery pack holds tens of kilograms of valuable metals; researchers hope to make recycling them easier and to reduce the amounts needed in future designs.

Battery cells come in cylindrical, prismatic and pouch varieties, and are arranged into modules that are assembled into packs as shown in figure 2. These packs are typically welded and glued together, which makes them hard to take apart at the end of their life cycle.

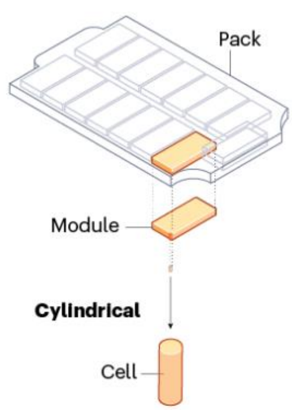

Fig2a: Cylindrical Battery packs

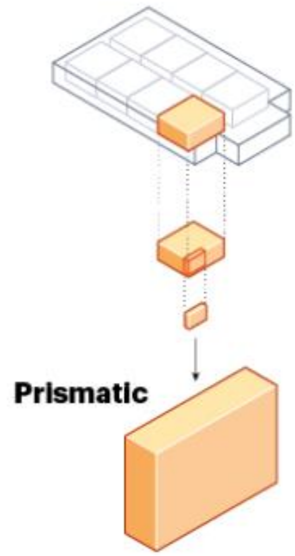

Fig2b: Prismatic Battery packs

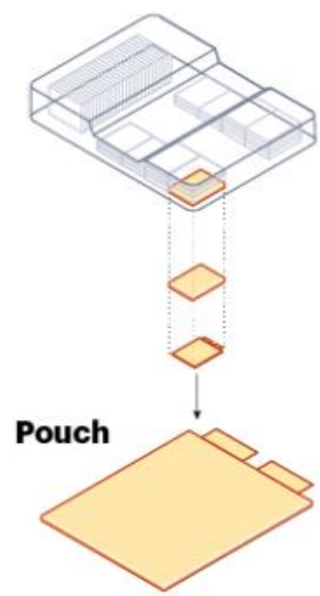

Fig2c: Pouch Battery packs

Battery packs typically contain substantial amounts of steel, aluminum, copper and polymers in addition to those components in the cells.

V. LITHIUM CELL STRUCTURE

The internal cell structure shown in figure 3, has sheet-like electrodes (anode and cathodes) curled up or sandwiched together, with an electrolyte taking up the space in between.

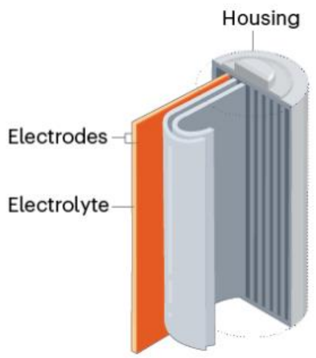

Fig 3a curled up sheet like structure

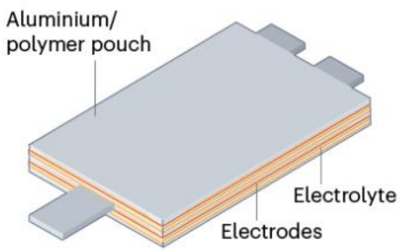

Fig3b sandwiched structure

VI. LITHIUM CELL CHEMISTRY AND TECHNOLOGY

Battery chemistries vary in their carbon intensities, and many automakers currently use energy-intensive chemistries such as lithium nickel cobalt aluminum oxide or lithium-ion phosphate. With battery innovation and scale, less of these materials will be used and they will come from more efficient manufacturing practice.

Figure 4 shows how, Lithium-ion cells generate electricity when lithium ions flow from the anode through an electrolyte to the cathode, forcing electrons to flow around an outside circuit. Charging reverses that process.

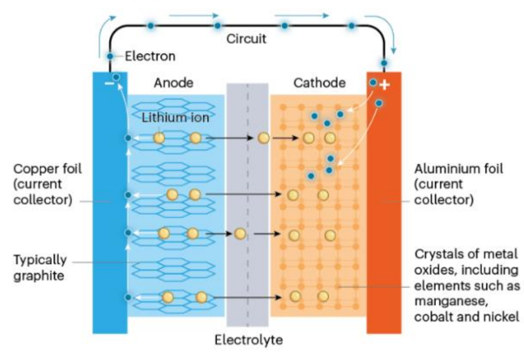

Fig 4. Flow of lithium ions

Lithium-ion batteries and manufacturing techniques continue to improve as the electric vehicle and stationary storage industries grow. Battery energy density, or the energy storage per kilogram of battery, continues to steadily increase at an average rate of approximately 5%–8% per year. Although this does not represent an equivalent reduction in materials or energy, one estimate shows that a 50% increase in battery energy density, which is achievable in 5 to 9 years with this estimated rate of improvement, would lead to a 10%–15% reduction in cumulative energy density (Linda, 2014). Additionally, other battery characteristics also are expected to improve, with associated environmental benefits. Longer battery lifetimes will allow for longer vehicle lifetimes and fewer replacements, as well as longer or more demanding second lives in stationary applications. Higher charging and discharging efficiencies will lead to lower energy consumption during the use phase of the vehicle battery.

Automotive lithium-ion batteries provide an opportunity for reuse in stationary storage applications after their vehicle use phase. This, in turn, allows the initial battery production footprint to be spread across more use. When batteries are removed from electric vehicles after their first life, they are likely to retain significant capacity, typically 75%–80% of their original capacity. They could, therefore, play an important role in supporting the electric grid, especially as intermittent renewables become more widespread (Jeremy Neubauer, Kandler Smith, Eric Wood, & Ahmed Pesaran, 2015).

CONCLUSION

Lithium ore and other raw materials required for the production of Batteries for electric vehicles are found in large commercial quantities in different Nigerian states. As electric vehicles continue to become more affordable and their sales share continues to grow; the growth which rely on the improvement in technology and sustainable supply of raw materials, specifically minerals and metals; most of which are in large deposits in Nigeria but are grossly underutilized. It is strongly believed that harnessing these resources will boast the economy and sustain industrial development in Nigeria.

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