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ENVIRONMENTAL IMPACT OF NON RECHARGEABLE VS. RECHARGEABLE BATTERIES FOR CONSUMER USE

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Abstract: **This study evaluates this assertion to guide future practice by both consumers and industry. The study compares re-chargeable batteries and non-rechargeable battery. The scope of the paper includes the distribution, use and disposal of the batteries and the battery charger. Energy use in wholesale and retail parts of the distribution system are also accounted for. Non rechargeable batteries were invented first, they are known as primary batteries; Rechargeable batteries are referred to as secondary batteries. Non-rechargeable batteries contain chemicals that create a surplus of electrons. Once these chemicals are exhausted, the charge is exhausted, and the battery is dead. A rechargeable battery contains a different set of chemicals that can store excess electrons which can be replenished using an electrical charge.The paper shows that Non rechargeable batteries have a long shelf life, while rechargeable batteries last longer. Non rechargeable batteries are cheaper than rechargeable batteries, but in the long run, rechargeable batteries prove to be profitable.Without batteries one would never have portable clocks that can be used to easily access the time. Although not a compulsory essential, watches have been said to be one of the most important concepts on a small scale business.**

Keywords: **Rechargable batteries, Non-Rechargable Batteries, Car Batteries, Watches, BatteryPrice, Charging and discharging.**

1. INTRODUCTION

A rechargeable battery, storage battery, secondary cell, or accumulator is a type of electrical battery which can be charged, discharged into a load, and recharged many times, as opposed to a disposable or primary battery, which is supplied fully charged and discarded after use. It is composed of one or more electrochemical cells. The term "accumulator" is used as it accumulates and stores energy through a reversible electrochemical reaction. Rechargeable batteries are produced in many different shapes and sizes, ranging from button cells to megawatt systems connected to stabilize an electrical distribution network. Several different combinations of electrode materials and electrolytes are used (amazon.com).

Rechargeable batteries typically initially cost more than disposable batteries, but have a much lower total cost of ownership and environmental impact, as they can be recharged inexpensively many times before they need replacing. Some rechargeable battery types are available in the same sizes and voltages as disposable types, and can be used interchangeably with them.

All over the world, small batteries are used to provide energy to appliances in households such as toys for kids, watches, remote controls of various electronic products, and many other items that are battery operated. Most of these batteries are non rechargeable, though there are appliances like mobile phones, digital cameras, light vehicles such as cycles, scooters,

and even cars that work on rechargeable batteries. Though, both type of batteries serve the same purpose of providing power to appliance.

Since non rechargeable batteries were invented first, they are known as primary batteries; Rechargeable batteries are referred to as secondary batteries. Canada was the first country to introduce rechargeable alkaline batteries that caught the imagination of the people. Today these batteries are available in all shapes and capacities. In fact, the invention of rechargeable batteries has made possible use and spread of cell phones across the world.

Talking of differences, one has to note that in normal or non rechargeable batteries a chemical reaction takes place that gives the necessary power to the appliances that use these batteries. It is this reaction that is reversed, and used to push electricity inside the cell in case of rechargeable batteries. This means that a normal primary battery would last only as long as its charge lasts, and it has to be discarded once this charge has been emptied. However, though rechargeable batteries can be charged again and again and reused, they too have a life, and this life is up to the time they have this ability to get charged. Once rechargeable battery loses the capability to get charged, it too needs to be discarded, but this does not happen before it has been charged 500-600 times. There are many types of chemicals used in rechargeable batteries and these combinations are referred to as lead acid, Nickel cadmium, Li-ion, and so on.

Non rechargeable batteries have a long shelf life, while rechargeable batteries last longer. Non rechargeable batteries are cheaper than rechargeable batteries, but in the long run, rechargeable batteries prove to be profitable. However, there are appliances that need non rechargeable batteries. This is because rechargeable batteries lose their charge quickly, and are thus, unsuitable in appliances such as smoke detectors and even digital cameras where rechargeable batteries get drained out quickly.

Impact of Batteries:

What is the impact of batteries on humankind?

Clearly there is both an adamant negative and positive impact of batteries on humankind. The basic positive impact is that everything is a lot easier for humans. There are numerous activities that have been made possible for us through the creation of batteries. For example:

Car Batteries: Car batteries have made mobility possible. Without this invention one would never be able to depend on such a reliable, easily accessible and quick form of transport. The introduction of automobiles has made a hugely positive impact on human kind. Nickel(2009) http://en.wikipedia.org.

Monitors: There are various types of monitors that are used today, one of the most common being the standard hospital heart monitor. These monitors are responsible for keeping people alive. As a source of education and examination, these have formed an incredibly vital part of the medical world.

Watches: Without batteries we would never have portable clocks that can be used to easily access the time. Although not a compulsory essential, watches have been said to be one of the most important concepts on a small scale.

Although batteries have facilitated a large range of discoveries and activities, they also have a negative impact on humankind. One of the most prominent negative impacts is the dependency on electronic appliances. As a embryonic world we have developed over many centuries, beginning with a very rural state and growing into a mechanical industrial world highly dependent of technology. Included in this technology is the battery. As one of the foundation blocks of society, communities have become largely dependent on batteries for necessities such as transportation and work, but also less essential activities including entertainment and leisure. As a global community we have survived in circumstances far more extreme than today without the help of batteries and futuristic technology, so it is evident that although accommodating, batteries can be considered unnecessary and therefore can be seen as a negative impact of humankind.

The second more prominent negative impact of batteries is their increasing harm to the environment.

2. NON RECHARGABLE VS. RECHARGABLE BATTERIES: A COST COMPARISON IN SUSTAINABILITY MARKETING.

A rechargeable battery, storage battery, secondary cell, or accumulator is a type of electrical battery which can be charged, discharged into a load, and recharged many times, as opposed to a disposable or primary battery, which is supplied fully charged and discarded after use. It is composed of one or more electrochemical cells. The term "accumulator" is used as it accumulates and stores energy through a reversible electrochemical reaction. Rechargeable

batteries are produced in many different shapes and sizes, ranging from button cells to megawatt systems connected to stabilize an electrical distribution network

Charging and discharging:

Battery charger:

During charging, the positive active material is oxidized, producing electrons, and the negative material is reduced, consuming electrons. These electrons constitute the current flow in the external circuit. The electrolyte may serve as a simple buffer for internal ion flow between the electrodes, as in lithium-ion and nickel-cadmium cells, or it may be an active participant in the electrochemical reaction, as in lead–acid cells.

Comparison	Rechargeable light	Non Rechargeable light
Cost	Relatively high cost	Relatively low cost
Durability	Do not last longer	Last longer
Battery	If well charged, can last for 48 hours	The battery can last for a month.
	Can only function if the battery is charged through electricity	Once, is filled with kerosene, or charged with solar it will function.
Hazard nature	When naked, it can kill	Can burn human
	Over recharged, destory the product	Over filled can explode.
Market demand	Higher	Lower
Maintenance	No additional cost provided there is electricity	Cost of buying its energy is high e.g kerosene

Where batteries can be used:

Batteries form an essential part of everyday life. As consumers, we make regular use of these electrical units to perform a variety of different things. When speaking about small electronic items, batteries are the most common systems that are used to power things such as cameras, cellular phones, watches, laptops, remotes, most flashlights and many other household items.

Every car is powered by an electrical car battery that enables mobility and these batteries are considered one of the most important purposes of batteries. Alkaline batteries are used to power these massive car batteries as well as radios, carbon-zinc batteries for children's play toys and torches. Lithium is mainly used in batteries for things such as your camera, a calculator or your watch but sometimes mercury is also used for these various items. Mercury is also used for hearing aids, which are also powered by silver and zinc batteries.

Batteries are a very important component in our day to day lives. To put it simply, they make everything a lot easier for us. Introducing a whole new spectrum of electronic appliances and equipment, we have easier ways to listen to music, know the time, travel faster and even listen without too much difficulty.

To execute these functions we need to choose between two types of batteries that are used today; Primary Batteries and Secondary Batteries. A Primary battery is more commonly known as a disposable battery and can be used for portable devices that demand an immediate and direct current when switched on. The advantage for homes is that these batteries are easily accessed but can only be used once and must be thrown away after. The other battery is not only a better option for households but is also a healthier option for the environment. These Secondary batteries are also know as rechargeable batteries, and must be charged before use. These batteries can be used many times, as they are rechargeable and perform the same job as a Primary battery.

In conclusion, we use batteries in many different areas but mainly to power items that are a major part of everyday life. Like we are dependent on our cars and our watches for the time, we are therefore dependent on batteries. They form a large purpose in our lives and must use safely. In order to verify this safety we must learn to dispose of our batteries correctly.

How batteries Can be disposed:

To begin with, there are few standard procedures that should be followed when dealing with batteries. Never dispose of batteries in a fire source because it is likely that they will explode. Make sure never to place batteries in a group because if they contain even a small amount of power, when banged together they may release a charge that could result in them catching fire which can have devastating results. When it is apparent that a battery can no longer power its appliance, it must be removed immediately because it may leak. And lastly, never place a battery in a pocket because it may burst and

cause another leakage. The first step to the adequate disposal of a battery is to place a powerless battery in some sort of container until you can correctly recycle it.

Every battery is now considered to be "hazardous waste." Because they contain very toxic metals such as Mercury, they have been classified as unsuitable to be thrown away as standard municipal solid waste. Batteries are not to be placed in communal 'dumps' because there is a chance that these toxic metals can have a serious and perpetual effect on the surrounding environment.*

Some of the batteries that are required to be accurately disposed of are batteries that can be found in; power tools, mobiles, various monitors, portable lamps, investigative electronic gear, flashlights etc.

Solar energy is radiant light and heat from the Sun that is harnessed using a range of ever-evolving technologies such as solar heating, photovoltaics, solar thermal energy, solar architecture, molten salt power plants and artificial photosynthesis.(*rsc.org.)*

It is an important source of renewable energy and its technologies are broadly characterized as either passive solar or active solar depending on how they capture and distribute solar energy or convert it into solar power

Over the past fifty years, many of the products we use have increasingly become powered by rechargeable batteries—from the lead acid batteries in our cars and other motorized vehicles, to the variety of rechargeable batteries powering our digital cameras, laptops, and other electronic devices. Choosing between rechargeable and disposable batteries can be frustrating. – Both types share many of the same properties and functions. Often the frustration stems from not knowing which will work better.

The most common debate about these two battery types surrounds consumer batteries. With different kinds of more efficient batteries appearing on the scene, such as the rechargeable battery, choosing can be a bit of a headache.

But in reality, there are only two main factors to consider.

Battery Price:

Rechargeable batteries are usually more expensive, at least initially.

Since rechargeable batteries can be charged many times over after the initial purchase, it is reasonable that rechargeable batteries comes with a much higher price tag than disposable non-rechargeable batteries. Having a lower initial cash outlay makes it one of the reasons that some consumers choose to purchase disposable batteries. But in the long run, the batteries that you can recharge are significantly more cost effective, often providing you with a hundreds or more hours of use than their disposable counterparts. The rechargeable battery for example, has proven to be efficient, especially in consumer electronics.

Battery Life:

Disposable batteries last longer than rechargeable batteries, but only initially.

The initial charge of a disposable battery tends to make it last significantly longer than its counterpart in most applications, making it the better buy at first glance. But remember, they are called “disposable” for good reason; they simply cannot be recharged. Once they die, they are dead and gone. When it comes to rechargeable batteries, they last much longer as you can recharge them. While it is true that rechargeable batteries lose drain more quickly over time and successive charges, there is never a need to re-purchase batteries for quite some time as long as they satisfactorily hold the charge needed for their application.

While the verdict may seem to be a no-brainer inclination in favor of the rechargeable battery, a case can be made for the usefulness of disposable batteries. It really depends on application. For example, non-rechargeable batteries can be the perfect choice for low-drain products. Low-drain devices use only occasional power or very low power over a longer period of time. Smoke detectors, remote controls, and wall clocks are just few of devices that could benefit from disposable alkaline batteries.

Rechargeable batteries can be the ideal choice for high-drain gadgets and electronics that quickly drain a lot of energy. Since these batteries can be easily recharged, you will be ridden of the hassle of constantly purchasing new batteries. Rechargeable batteries, which are commonly used to power portable consumer electronics, are a better choice for such devices, and will give you more bang for your buck.

There are always pros and cons with the variety of batteries available. The first consideration in purchasing the most suitable battery for any device is its application (microbattery.com, 2014)

Damage during storage in fully discharged state:

If a multi-cell battery is fully discharged, it will often be damaged due to the cell reversal effect mentioned above. It is possible however to fully discharge a battery without causing cell reversal—either by discharging each cell separately, or by allowing each cell's internal leakage to dissipate its charge over time.

Even if a cell is brought to a fully discharged state without reversal, however, damage may occur over time simply due to remaining in the discharged state. An example of this is the sulfation that occurs in lead-acid batteries that are left sitting on a shelf for long periods. For this reason it is often recommended to charge a battery that is intended to remain in storage, and to maintain its charge level by periodically recharging it.

Depth of discharge:

Due to variations during manufacture and aging, the DOD for complete discharge can change over time or number of charge cycles. Generally a rechargeable battery system will tolerate more charge/discharge cycles if the DOD is lower on each cycle *(Suzanne, 2016).*

Lifespan and cycle stability:

If batteries are used repeatedly even without mistreatment, they lose capacity as the number of charge cycles increases, until they are eventually considered to have reached the end of their useful life. Different battery systems have differing mechanisms for wearing out. For example, in lead-acid batteries, not all the active material is restored to the plates on each charge/discharge cycle; eventually enough material is lost that the battery capacity is reduced. In deep discharge, some reactive lithium metal can be formed on charging, which is no longer available to participate in the next discharge cycle. Sealed batteries may lose moisture from their liquid electrolyte, especially if overcharged or operated at high temperature. This reduces the cycling life.

What is the difference between Rechargeable and Non Rechargeable Batteries?

• Non rechargeable batteries are called primary batteries, while rechargeable batteries are called secondary batteries

• A chemical reaction goes inside non rechargeable batteries' that release electricity needed to run appliances

• The chemical reaction can be reversed to send or rush electricity inside rechargeable batteries to charge them

• Non rechargeable batteries are cheaper than rechargeable batteries that however prove to be more cost effective because of their ability to be recharged hundreds of times.

Charging and discharging:

During charging, the positive active material is oxidized, producing electrons, and the negative material is reduced, consuming electrons. The energy used to charge rechargeable batteries usually comes from a battery charger using AC mains electricity, although some are equipped to use a vehicle's 12-volt DC power outlet. The voltage of the source must be higher than that of the battery to force current to flow into it, but not too much higher or the battery may be damaged.

Chargers take from a few minutes to several hours to charge a battery. Slow "dumb" chargers without voltage or temperature-sensing capabilities will charge at a low rate, typically taking 14 hours or more to reach a full charge. Rapid chargers can typically charge cells in two to five hours, depending on the model, with the fastest taking as little as fifteen minutes. Fast chargers must have multiple ways of detecting when a cell reaches full charge (change in terminal voltage, temperature, etc.) to stop charging before harmful overcharging or overheating occurs. The fastest chargers often incorporate cooling fans to keep the cells from overheating. Battery packs intended for rapid charging may include a temperature sensor that the charger uses to protect the pack; the sensor will have one or more additional electrical contacts.

Different battery chemistries require different charging schemes. For example, some battery types can be safely recharged from a constant voltage source. Other types need to be charged with a regulated current source that tapers as the battery

reaches fully charged voltage. Charging a battery incorrectly can damage a battery; in extreme cases, batteries can overheat, catch fire, or explosively vent their contents.

3. ALTERNATIVES

A rechargeable battery is only one of several types of rechargeable energy storage systems. Several alternatives to rechargeable batteries exist or are under development. For uses such as portable radios, rechargeable batteries may be replaced by clockwork mechanisms which are wound up by hand, driving dynamos, although this system may be used to charge a battery rather than to operate the radio directly. Flashlights may be driven by a dynamo directly. For transportation, uninterruptible power supply systems and laboratories, flywheel energy storage systems store energy in a spinning rotor for conversion to electric power when needed; such systems may be used to provide large pulses of power that would otherwise be objectionable on a common electrical grid.

Ultracapacitors: capacitors of extremely high value— are also used; an electric screwdriver which charges in 90 seconds and will drive about half as many screws as a device using a rechargeable battery was introduced in 2007, *(Ohgizmo.com. 2005, Retrieved 14 August 2012).* and similar flashlights have been produced. In keeping with the concept of ultracapacitors, betavoltaic batteries may be utilized as a method of providing a trickle-charge to a secondary battery, greatly extending the life and energy capacity of the battery system being employed; this type of arrangement is often referred to as a "hybrid betavoltaic power source" by those in the industry. (CityLabs.net website,2016)

Ultracapacitors are being developed for transportation, using a large capacitor to store energy instead of the rechargeable battery banks used in hybrid vehicles. One drawback of capacitors compared to batteries is that the terminal voltage drops rapidly; a capacitor that has 25% of its initial energy left in it will have one-half of its initial voltage. By contrast, battery systems tend to have a terminal voltage that does not decline rapidly until nearly exhausted. The undesirable characteristic complicates the design of power electronics for use with ultracapacitors. However, there are potential benefits in cycle efficiency, lifetime, and weight compared with rechargeable systems. China started using ultracapacitors on two commercial bus routes in 2006; one of them is route 11 in Shanghai. (52Bus.com website, 2006)

Flow batteries, used for specialized applications, are recharged by replacing the electrolyte liquid. A flow battery can be considered to be a type of rechargeable fuel cell.

Benefits of Rechargeable Batteries:

- **Save Money:** When used properly, rechargeable batteries can be used hundreds or even thousands of times! They do cost more initially, but can definitely pay for themselves over time.
- **Conserve Resources:** Because rechargeables can be used over and over, fewer batteries need to be manufactured (and transported) than with single use varieties. In fact, rechargeable batteries consume up to ***23 times*** less non-renewable natural resources than disposable batteries.
- **Protect the Environment:** Most people don't realize the extent of single use batteries' environmental impacts.
- **Performance:** Many of today's rechargeables actually last longer on a single charge than their disposable counterparts, especially in high-drain devices.

Disadvantages of Rechargeable Batteries:

- **Recharging:** Obviously, rechargeable batteries will need to be recharged. If you are used to just grabbing single use batteries and popping them in, recharging can initially seem like a bit of a hassle. Having backups helps ensure you won't be left powerless waiting for your batteries to juice up.
- **Self-Discharge:** Some self-discharge can be expected, meaning you may need to charge batteries before their initial use and after storing for any length of time. Opt for pre-charged versions and again, be sure to keep those backups charged.

Product Suggestions:

Once a fringe item, rechargeable batteries are now widely available at supermarkets, convenience stores, wholesalers, and from many online retailers. Increasing brand competition and availability means it's now easier and more affordable than ever to make environmentally-friendly choices. Consequences of Charging a Non-Rechargeable Battery.

A non-rechargeable battery, or primary cell, will overheat if placed in a battery charger. Even a normal rechargeable battery will increase slightly in temperature when charged, as will the charging mechanism. When the non-rechargeable battery overheats the seals will break, causing the battery to leak or explode. If the battery explodes the chemicals will spread all over the immediate area, which is serious health hazard. In extreme cases, the battery may burst into flames. If the heat does not effect the battery enough to open the seal, nothing happens, but the battery will most likely be useless afterwards.

How Non-Rechargeable Batteries Work:

The reason for these extreme reactions is that non-rechargeable batteries contain chemicals that create a surplus of electrons. Once these chemicals are exhausted, the charge is exhausted, and the battery is dead. A rechargeable battery contains a different set of chemicals that can store excess electrons which can be replenished using an electrical charge. Over time, however, even a rechargeable battery will lose its ability to store these excess electrons and will no longer be able to contain a charge. When one tries to charge a non-rechargeable battery using electricity they are acting against both the physical shell of the battery and the chemical processes contained within. (*Bill,2015)*

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