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BLADE BATTERY: A SPECIALLY DESIGNEDPOWER DELIVERY BATTERY

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ABSTRACT
This article presents the concept about BYD's blade battery. The development of many things takes place according to the circumstances at that period. Similarly, one thing that has been developed and going to be developed is a 'battery' for electric vehicles. Due to the lack of resources and limited sources, electric vehicles are being launched from various manufacturers. To charge that electric vehicle, batteries are being made. Time to time, the battery technology is being improved and different types of batteries are being developed. Among those wonderful inventions, BYD's blade battery is one of them. Blade battery has improved its competitiveness throughout the world. It has its own advantages compared to other batteries regarding battery safety and energy density.
Keywords: Power battery, blade battery, lithium iron phosphate battery, nail penetration test, surface temperature, endurance capacity, energy density.

INTRODUCTION
At present, due to the vehicles that are being utilized by humans, increase the pollution. To control the pollution some of the alternatives are being used. Electrical vehicles usage makes great changes in the world. There are more advantages because of electrical vehicles. There should be pollution free batteries that are used in electric vehicles to make green society and environment. BYD announced the launch of blade battery in march 2020. Blade batteries are eco-friendly and also have minimum safety problems. So, some of the manufacturers have referred them and also applied them to the products. These are also used in the research fields. This paper specifies the matter about the blade battery and its advantages.

POWER BATTERIES: A power battery is a device that stores energy and discharges it by converting chemical energy to electrical energy. Ternary battery is a kind of lithium-ion battery. From the table-1 below, NCA and NCM are ternarybatteries. NCM refers to lithium-ion batteries having positive electrode material that is composed of nickel, cobalt and manganese but NCA refers to lithium-ion batteries that are traded manganese of NCM to Aluminium. LFP refers to lithium iron phosphate battery, LMO refers to lithium manganese oxide battery and LCO refers to lithium cobalt battery [10]. These are types of power batteries. The table-1 gives the comparison of the power batteries.

BLADE BATTERY AS LITHIUM IRON PHOSPHATE BATTERY: The blade battery is a lithium iron phosphate battery andit got its name due to its long shape and thin thickness [4]. Its features are similar to that of LFP which is mentioned in the table-1. It's specifications as below. These specifications made blade battery more advantageous compared to ternary batteries[7].

- Chemistry = LiFePO4 (LFP)
- Capacity = 202 Ah
- Nominal Voltage = 3.2 V
- Maximum Charging Voltage = 3.65V
- Energy Content = 646.4 Wh
- Dimensions = 960mm (L), 90mm(W), 13.5mm (H)
- Volume = 1.17litres

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- Volumetric Energy Density = 552Wh/L
- Weight 3.9 kg [3]
- Gravimetric Energy Density = 166Wh/kg
- Cycle Life 3,000+ cycles

Simple Comparision among Power Battery

	Ternary Battery		LFP	LMO	LCO
	NCA	NCM			
Energy Density(Wh/kg)	>180	200-280	120-190	130-150	150-180
Voltage(V)	3.7	3.6	3.2	3.8	3.7
Cycle life	>2000	>2000	over 10000	500-800	>1000
cost	High	high	low	lowest	A bit high
Material Resources	Cobalt is rare	Cobalt is rare	Rich Resource	Rich Resource	Cobalt is rare
Temperature Range	-30-65℃	-30-65℃	-20-70℃	-20-45℃	-20-80℃
advantage	1.High energy density 2.Good low temperature performance	1.stable electrical chemistry 2.Good cycle performance	1.Higher safety 2.Good cycle performance	1.safe 2.low cost	1.stable charging and discharging 2.simple manufacturing process
Disadvantages	1. poor in safety 2. High manufacturing technology 3. High raw material price	1. Cobalt is expensive	1. poor in low temperature 2.Low discharge voltage	1. Poor in safety 2. Low energy density 3. Short battery life	1. cost high 2. Short cycle life 3. Poor in safety

Table.1. *Simple comparison among power battery [5].*

NAIL PENETRATION TEST OF BLADE BATTERY:

Testing of batteries is necessary even though they are equipped with protective components or elements and circuit for the purpose of safety. Nail penetration test is also a type of safety testing in which a sample battery is tobe penetrated using a nail to a charge depth of 100% to simulate an internal short circuit. BYD stated that the blade battery neither emitted smoke nor fire after it's been penetrated during nail penetration tests. The surface temperature of the blade battery only reached 30 to 60deg. From thisits been said that eventhough EVs which are equipped with a blade battery are severely damaged,they have low probability of catching fire[2,3].

CONCEPT OF BLADE BATTERY:

Blade battery has long shape and thin thickness. The selection of batteries for EV depends on their endurance capacity and energy density. Due to the improvement of energy density, the layout of the internal space and package space of the battery is optimised. It can fulfil the requirements to be used for an EV. Blade battery is a lithium iron phosphatebattery. Due to the physical structure of this battery,it is called as a blade battery. In blade battery singular cells are arranged together in an array and that arranged cells are inserted into battery pack. Compared to conventional lithium iron

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phosphate block batteries, the space utilization of the battery pack is increased by 50% due to its optimized battery pack structure.

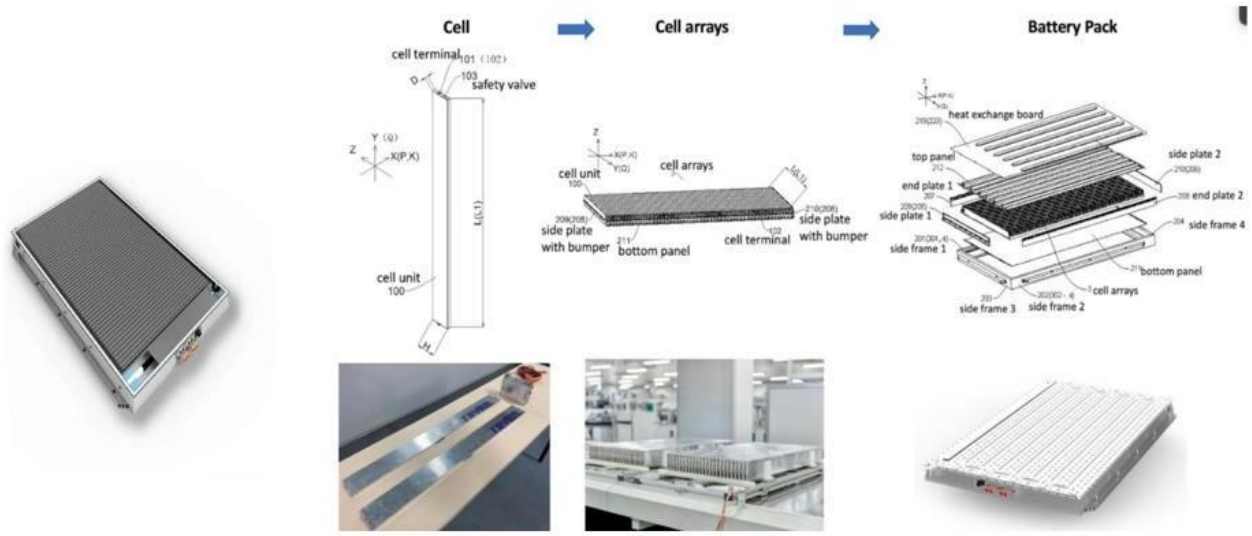

Fig.1. Blade battery and its structure [9]

The blade battery has passed several tests like nail penetration tests, other conditions like crushing, bent, being heated in a furnace to 300deg and overcharged by 260% and during the tests or completion of tests, it neither exploded nor emitted fire. The main motto of the implementation of the blade battery is that to bring battery safety back to the forefront as it's very important aspect and a specification of a battery[1,8].

The chairperson of the BYD, Wang Chuanfu said that the Blade Battery reflects BYD's determination to resolve issues in battery safety while redefining safety standards for the entire industry. Professor Ouyang Minggao, Member of the Chinese Academy of Sciences and Professor at Tsinghua University said that in terms of battery safety and energy density, BYD's Blade Battery has ovious advantages. These are the words said bychairman of BYD, Wang Chuanfu and professor Ouyang Minggao who is a professor at Tsinghua University about BYD's blade battery[1].

Other than volume utilization and energydensity there are other advantages of blade battery. It is cheaper than the ternary lithium battery in cost since there is no usage of nickel and cobalt in its manufacturing [4]. With a blade battery, BYD Han EV has a range of 605 kilometers and an acceleration of 0 to 100km/h in just 3.9seconds under comprehensive working conditions[1,8]. But the main disadvantage of blade battery is that it has poor performance of charging and discharging at low temperatures which is a disadvantage of lithiumiron phosphate battery. Compared to ternary lithiumbattery, blade battery is highly stable. Blade battery has better thermal stability and higher safety. Blade battery has a high starting temperature for exothermic reactions, slow heat release and low heat generation. It also has an ability to not release oxygen during breakdowns or easily catch fire[6].

CONCLUSION:

Even though the world is developing continuously, certain things should be applied and implemented so that the development become as green development. There are so many advantages of batteries but the major aspect that should be taken in mind is that waste battery treatment. Blade battery also has the problem of waste battery treatment which is not properly handled. Despite of this problem, the blade battery has a great scope and also has many advantages which are required to be used in EVs. In future, EVs are used at high rate and batteries like blade battery will have great scope. As green development is the main theme at present and EVs are adapting to this. EVs will be developed

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and there will be development in the battery technology.

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