

# *A Review of Hazards for Lithium – Ion Battery Applied in Tactical Radio*

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**Abstract**— This paper presents the review hazards of Lithium-ion battery, quality and military safety standard. Nowadays, Lithium – ion battery is a popularly used in general industry and military mission, especially in military tactical radio as renewable energy source because old-fashioned Nickel Cadmium and Nickel Metal Hydride batteries have many disadvantages. But Lithium – ion battery is more suitable for military mission because of lightweight, compact design, high energy density, low of discharge rate and no memory effect. However, Lithium – ion battery is more expensive and risk of accident if improperly handling. The main hazards of Lithium – ion battery are chemical vapor, fire and explosion from processes of manufacturing, using, charging, transportation, storage and disposal. Thus, safety and quality standard must be strictly controlled in order to ensure the safety of user.

**Keywords**— *Lithium – Ion Battery, tactical radio, hazard of lithium – ion battery .*

## I. INTRODUCTION

At present, Lithium ion battery is getting more popular in the rechargeable battery market. From market research data shows that lithium ion cell market keeps increasing by approximately 20% annually. The main reason for lithium ion battery popularity is the chemistry's high specific energy (Wh/kg.) and high energy density (Wh/L), on the other hand, Lithium-ion batteries will provide substantially more energy than other battery technologies at the same size and weight. Lithium ion batteries have enabled smaller, thinner and more portable designs. Now the Lithium-ion batteries are readily available and cost has been cheaper. Therefore, they are more likely to be chosen for use in a wide range of applications [1].

In many military electronics equipment are now still using ,such as tactical radio, Nickel Cadmium and Nickel Metal Hydride batteries which will be considered to change to Lithium ion battery due to its many advantages i.e. lightweight, high energy content and slow discharge rate. But there are safety aspects to carefully study prior to change in order to avoid potential hazard of users.

## II. LITHIUM – ION BATTERY FOR TACTICAL RADIO

### A. Type of Lithium – ion battery

A battery is a device that used to store the energy. It directly converts chemical energy into electrical energy by electrochemical oxidation - reaction. There is various type of material that use in battery such as, cadmium, zinc, lead, manganese, mercury etc. Battery can contain one or more cell that arranged in series or parallel connection to supply the energy to the equipment at required voltage and current [2]. Battery has 2 polarities, anode and cathode. During discharging (supplying the energy), ion flows from the anode to cathode via electrolyte. On the contrary, ion flows in reverse direction from the cathode to the anode while charging. Lithium-ion batteries are available in many types. All of them use Lithium-ion as common material and mix with other material to create a unique characteristics and performance as shown in Table I [3].

TABLE I. TYPE OF LITHIUM – ION BATTERY [4]

Chemical name	Material	Abbreviation	Short form	Notes
Lithium Cobalt Oxide <sup>1</sup> Also Lithium Cobalate or Lithium – ion - cobalt	LiCoO <sub>2</sub> (60% Co)	LCO	Li - cobalt	High capacity, for cell phone, laptop, camera
Lithium Manganese Oxide <sup>1</sup> Also Lithium Manganate or Lithium – ion – manganese	LiMn <sub>2</sub> O <sub>4</sub>	LMO	Li – manganese , or spinel	Most safe, lower capacity than Li – cobalt but high specific power and long life.
Lithium Iron Phosphate <sup>1</sup>	LiFePO <sub>4</sub>	LFP	Li – phosphate	Power tools, e – bikes, EV, medical, hobbyist.
Lithium Nickel Manganese Cobalt Oxide <sup>1</sup> Also Lithium – Manganese – Cobalt – Oxide	LiNiMnCoO <sub>2</sub> (10 -20% Co)	NMC	NMC	
Lithium Nickel Aluminum Oxide <sup>1</sup>	LiNiCoAlO <sub>2</sub> (9% Co)	NCA	NCA	Gaining importance in electric powertrain and grid storage.
Lithium Titanate <sup>2</sup>	Li <sub>4</sub> Ti <sub>5</sub> O <sub>12</sub>	LTO	Li - titanate	

Notice: 1 = Cathode Material, 2 = Anode Material