

Improperly Designed Battery Packages Result in Partially Discharged Cells

OddMix.com - Power Technical Note - PWRN0702 - by Karl Nagy



Humid weather can be quite deadly to "dry" cells. That was the conclusion based on the available evidence. Observe the rust on **Picture 1**. in front of the arrow. Recently, a newly opened "fresh" package of batteries, was found weak and uncharacteristically depleted out of the pack. That was puzzling since these batteries have date markings on their sides to indicate their potential shelf life. But those promises of many more years were short lived in this case. To add insult to injury these batteries were not even returnable, because the original package had to be opened to expose this bunch of expensive duds.

Picture 1. Red oxide spots on battery

Initial reaction to the first "dead on arrival" was that it had to be a factory produced reject which somehow evaded all

the careful quality controls. Commodities such as transistors or batteries which are produced in massive amounts are seldom tested individually. Instead quality assurance is done by statistical sampling.

The factory reject idea was short lived, and unhappiness increased as one after another of the overadvertised, overpriced technological masterpieces were found unserviceable. Many of them had less life left in them, than the ones they were supposed to replace. The batteries weight was reasonable uniform, and similar to the old depleted units. This and that they were still sealed suggested that partial or complete electrolyte loss was out of the question. Also supportive of that idea was the fact that alkaline batteries (especially larger cells) do not usually dry out.

A thorough visual examination of the packaging material provided the evidence to what ailment had sickened these "premium" batteries. The back of the package was cardboard, plain and brown on the inside, richly printed all over on the outside. At first the paper appeared completely above suspicion that it can conduct electricity at all. Rustmarks on the cardboard where the battery plus terminals contact it, and similar rust marks on the positive battery terminals - **Picture 2**. - suggested that not only the paper conducted, but that it did that for a long time. Since the plastic wrapper was intact, it appeared that trapped moisture wetted the paper enough to load the batteries within the enclosed package.



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Picture 2. Oxide spots on new batteries

Unfortunately, the plastic wrapper forced the paper to stay in touch with both sides of the battery terminals. Under those conditions, all it required is some time to discharge the batteries. Although clear plastics was used, the conduction marks were completely invisible from the outside, as the battery terminals were blocking the contact points from view.



Lets assume for a moment that this packaging fiasco was just an honest mistake and not a newly invented marketing tool to increase battery sales. Hopefully many customers noticed that their batteries lasted much less than usual, and complained to the manufacturer vigorously. Perhaps the factory people had seen the light and modified the packages to make them out entirely of nonconductive materials. Even a light oil, or silicone coating would have stoped moisture penetration and could have arrested or greatly reduced unwanted battery discharge.

Picture 3. Conduction marks

It appears to be wise to stay away from similarly packaged batteries. Smaller cells pack lot less Ampere hours then larger ones. Therefore, they deplete lot faster under similar storage conditions. It is advisable to remove batteries from their packaging materials as soon after purchase as practical. It is a good idea to store them in the refrigerator, but without wrapping because of the moisture condensation that will occur. Always store them with one terminal free and clear of any objects.

If everything seems to be in order, they would indeed last longer in cold temperatures. Keep them from freezing as that would ruin the cells seal for good. Short of freezing, the colder the better for long term storage, since chemical reactions are slow down in colder environments.

Pictures 3. and **4.** shows conduction marks on both the packaging materials and on the cell terminals. On cells out of a fresh package there should be absolutely no marks like those whatsoever. If a similarly rusted cell is discovered, and it still have some charge left, clean the terminals from all of the rust before putting them to use. Otherwise the rust will interfere with the flow of the current and the cells would appear worst then they actually are.



Picture 4. Conduction marks on cardboard

Do NOT try to recharge alkaline batteries. Since they are sealed, gas pressure buildup would ruin the experiment. If the charge current is large they can explode. Once the electrolyte is forced out by the increased internal pressure, it will corrode whatever it comes into contact. If a leaky cell is discovered and the electrolyte comes into contact with skin, wash it off at once! The alkaline electrolyte is capable to dissolve the skin, and it can severely damage the eyes if it comes in contact with them. Wear eye

protection when working on batteries, and wash all affected areas promptly and thoroughly.

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