Free Range Practice Guide No. 1:

Beyond the Throw-away Battery

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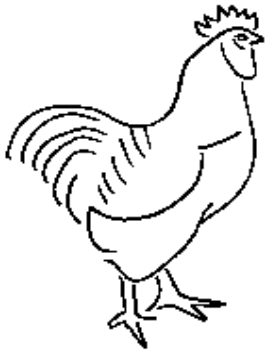

Save money using rechargeable batteries and using main power supplies for portable equipment – and in the process save waste an pollution.

In the 1960s electrical equipment became more portable – and so the mass consumption of batteries was initiated. But the battery is an imperfect device. It delivers less power than is used in its manufacture. Then, when exhausted, it's a 'toxic problem' to dispose of. They are also, for the amount of power they deliver, very expensive.

This need not be the case. We can use the alternatives to the use-once-and-throw-away power source.

Recharge it!

A few years ago most batteries were zinc-acid based. Today most of the batteries sold are alkaline because of their greater capacity. But there are two alternatives:

Nickel-Cadmium batteries, or NiCads, have been common for a number of years. They can cost 50% to 100% more than conventional batteries, but they can be recharged many times.

The other type, Nickel-metal Hydride, or NiMH, are a recent innovation. They have a higher storage capacity than NiCads, but also cost more. They also require higher-quality chargers.

You can replace ordinary batteries with either NiCads or NiMH in many situations – but not all. This is because of the internal behaviour of rechargeable batteries. If you have an application where you regularly replace batteries, rechargeables work well – e.g. radios, test equipment, torches and personal stereos. But they are very bad in devices that use very little power – e.g. clocks, or equipment that you leave on standby for long periods between use, such as seldomly used torches.

NiCads and NiMH batteries are advertised as being able to be recharged 600 or 1,000 times. But this does not make them equivalent to 1,000 alkaline batteries. Neither NiCads nor NiMH provide more power than alkaline batteries. Therefore, in terms of power provision, you have to replace them more often. The figures for recharging quoted also represent charging under 'ideal' conditions – which most people will not practise. Therefore, when comparing rechargeable to alkaline batteries, it's more like 200 or 300 alkaline batteries are equivalent to one rechargeable.

Factoring all this in, the savings from the use of rechargeable batteries is truly huge. A set of two AA type NiCad batteries, common in most personal stereos, will cost around £3.50 to £4.00. But, in terms of the 400 or so alkaline batteries you will not use, you will save over £330.

Battery chargers

To use rechargeable batteries you need a charger. Unlike a car battery, you can't just connect a NiCad or NiMH to the juice. They have to be charged at a specific voltage, at a certain rate. Charging outside of these limits will damage the battery, and/or shorten its working life.

Battery chargers vary in price. This is because of the way they work. The cheapest are very accurate voltage regulators – so you have to remember when to turn them off. The more expensive are computerised. These actually study the performance of the battery under charge, respond to its needs, and turn themselves off. These more complex chargers will extend the life of your battery, enabling you to get more recharges out of it. NiCads and NiMH batteries behave slightly differently when under charge. Therefore you should only charge NiMH batteries with a charger designed for use with NiMH batteries.

A cheap charger for NiCads will cost around £10. The chargers for NiMH batteries require the type of control used in the more complex NiCad chargers. Therefore most high price NiCad chargers will also charge NiMH batteries. These more complex chargers cost £20 to £30.

Some chargers incorporate a solar panel. Some people see these 'solar chargers' as being very green. In fact, they're the opposite. Most of them have a very small solar cell. This means that to get a voltage and current high enough to charge the battery you have to put them in direct sunlight. Once they fall out of direct sunlight the charger cannot maintain the right voltage and current to properly charge the battery. This affects the life expectancy of the battery because it is not being charged under ideal conditions. What little benefit you might gain from not using the mains is

Batteries – the techie talk

Batteries come in standard sizes - but different states have different labels to describe them. The scheme widely used at the moment is the US standard - 'AAA', 'AA', 'C' and 'D', plus '9V' (which is not part of the US scheme). The following table provides information on the different types of battery in common use - alkaline, nickel-cadmium and nickel-metal hydride:

Type	AAA	AA	C	D	9V
Other labels	MN2400, HP16, AM4, LR03	MN1500, HP7, AM3, LR6, R6HP	MN1400, HP11, AM2, LR14, R14HP, C11, SP11	MN1300, HP2, AM1, LR20, R20HP, SP2	MN1604, AM6F, 6LR61, 6LF22, PP3HP, PP3, 006P
Size, mm	10.5 (dia) x 45	14.5 (dia) x 50.5	26.2 (dia) x 50	34.2 (dia) x 61.8	26.5 x 48.5 x 17.5
Weight, g (approx)	12	25	62	135	48
Alkaline batteries:					
Capacity, mAh	1200	2600	7800	16500	550
Voltage, V	1.5	1.5	1.5	1.5	9
Nickel-Cadmium (NiCad) batteries (rechargeable):					
Capacity, mAh	240	800	1700	1700	110
Voltage, V	1.2	1.2	1.2	1.2	8.4
Alkaline ratio -	5	3	4	10	5
Nickel-Metal Hydride (NiMH) batteries (rechargeable):					
Capacity, mAh	550	1400	2200	2200	150
Voltage, V	1.2	1.2	1.2	1.2	8.4
Alkaline ratio -	2	2	4	7.5	4

The main difference between each type of battery, apart from rechargeability, is their capacity. Battery capacity is rated in Amp-hours (Ah). A 1Ah battery will deliver 1Amp (A) for 1 hour (h), 0.5A for 2h, 0.25A for 4h, etc. Consumer batteries are usually rated in milliAmps - mA. 1mA is one thousandth of an Amp.

Another major difference is the voltage. Non-rechargeable batteries operate at 1.5 or 9 volts. Rechargeables operate at either 1.2 or 8.4 volts. Ultimately these differences result in a different level of performance. This is illustrated in the table as the 'alkaline ratio – the number of recharges to deliver the same power as an alkaline cell. NiCad batteries generally have to be replaced four to five times as often, and NiMH three times as often.

therefore lost many times over because you shorten the life of the battery. For those who want to be green, it would be far better to economise on their use of energy and chemicals than charge batteries with an inefficient solar charger.

Power supplies

Many battery powered devices also have a socket that allows you to plug a power supply into them. The only problem you have using this socket will be finding a mains transformer and plug that fit your appliance. The transformer takes the 230-volt mains supply and steps it down to the required voltage. For battery powered equipment a 'direct current' or 'DC' voltage is required. Therefore the supply will also 'rectify' the 'alternating current' (AC) of the mains to produce DC.

Power supplies can be 'regulated' or 'unregulated'. Regulated power supplies are much better if your device uses little power because an unregulated transformer will provide a higher voltage than stated if you use too little current. But regulated supplies are also better because they prevent power surges from the mains supply being transmitted into your appliance – which might damage it. The other key feature is either a fixed or variable voltage. If you want to use the same transformer to power a variety of equipment at different times then variable is more flexible. But if you want to buy something for a specific device, fixed is definitely safer – because there's less chance of getting the voltage wrong.

The other important factor related to regulation is the amount of power required by your device. All devices that have a power socket should have written on them how much power they require. This will either be quoted as a current – for example '3 amps' or '3A' – or as a power rating – for example '50 watts' or '50W'. You must ensure that the power supply that you plug into the appliance has sufficient capacity. That's common sense. But you must also ensure that the capacity of the power supply does not exceed twice that of the appliance. This is because too high a supply capacity could mean that the over-voltage protection or current limiting features of the regulator do not work properly. In the event of a fault your appliance may be supplied with a large amount of power, and could be seriously damaged as a result.

Finally, transformers/power supplies are fitted with a standard type of power plug connector. But there is more than one size of the same plug design. Therefore be sure

that the connector is right for the appliance you want to use it with. If in doubt, some supplies come with a combination of four different connectors at the end of the lead, so you can try each until the plug fits. Some supplies also come with a switch or plug-and-socket connection that allows you to change the polarity of the power supply. The instructions with the supply will tell you how to change this. But be sure to get it right, otherwise the equipment will not work.

The cost of power supplied varies. A fixed, unregulated, low current supply can cost £7 to £10. A fixed voltage, regulated, low current supply can cost £10 to £12. Higher current transformers, for powering low voltage equipment such as portable TVs, drills or saws, cost £30 or more. Variable power supplies usually cost around 15% to 20% more than their fixed equivalents. In general use, a good power supply should last many years, providing that you do not regularly use it up to its rated capacity. For this reason a plug-in power supply represents a far more cost-effective and environmentally sound option than powering equipment with a battery.

The 'beyond throw-away' Nirvana – wind-up!

If you have a choice, rechargeable batteries are far more environmentally sound, and far cheaper, than use-once batteries. Better still, a power supply can do away with the need for batteries altogether, or more effectively, reduce the need to recharge your batteries on a regular basis so lengthening the life of the rechargeable battery pack. But, as new equipment requires less power, and becomes more efficient, a new option has emerged – the 'wind-up' appliance.

The revolution on 'self-powered' equipment began with Trevor Bayliss' Freeplay wind-up radio. This used a large clockwork device to produce power. You wind-up the clockwork mechanism which stores energy in a large spring. When you turn on, the clockwork mechanism slowly unwinds, turning a dynamo, which provides power to the radio. The next development from the clockwork device was the 'hybrid' power device. This is where you wind a geared mechanism, which turns a dynamo, which charges-up the device with power to allow it to run. Here energy is stored as energy in a battery, rather than a spring.

Today the variety of wind-up equipment is growing rapidly. After radios, the next major wind-up device were torches. A recent innovation has been the wind-up mobile phone charger. All wind-up powered devices have one thing in common – they are very efficient. They have to be very efficient in order to run on the very small amounts of power that human-induced charging produces. This strikes at the heart of the whole issue over the use of power in society. It's not just a matter of how we produce energy, and the environmental impact this has. It is also important that we challenge the way that power is used. A good example is the guide that you are reading at this moment. It was produced on a laptop computer. Laptop computers use less than one-fifth the power of a desktop computer.

The Cost Savings of Using Rechargeable Batteries

Rechargeable batteries cost more. But you must balance this higher cost against the potential savings on the money your would have spent on convention lead/acid or alkaline batteries.

Assuming you get 200 battery-equivalents from a set of NiCad batteries (see main text on why 200) the cost saving, **per battery**, for each battery type are as follows:

Type	Price, Alkaline	Price, NiCad	Alkaline x200 cost	NiCads saving
AAA	£0.80	£1.50	£160.00	**£156.90**
AA	£0.85	£1.60	£170.00	**£166.70**
C	£1.35	£2.50	£270.00	**£264.80**
D	£1.50	£3.00	£300.00	**£294.00**
9V	£2.50	£5.00	£500.00	**£490.00**

How savings are calculated:

The alkaline battery price assumes that they are bought in packs of four to six, to save money. The NiCad price assumes that they are brought in packs or one or two.

It is assumed, as a general rule of thumb, that the cost of recharging a battery is 1% of the cost of the ordinary battery.

The cost saving is therefore the cost of 200 alkaline batteries, minus the cost of the NiCad, minus the cost of 200 recharges (1% of the alkaline battery price)

Summary

We all use energy. But when we need to be portable, the use of that energy has a financial and environmental cost far higher than our use of energy via the mains supply. It is important that we tackle our use of portable power to minimise these impacts.

Using rechargeable batteries represents a huge cost and environmental saving over use-once batteries. Even though you need to replace them more often, a set of rechargeable batteries will save you many hundreds of pounds by reducing the need to buy batteries. It will also save many kilos of toxic waste being produced, and disposed of to polluting/toxic landfill sites.

Using a mains power supply is better still. This is because it is cheaper and far more environmentally efficient than using even rechargeable batteries. For this reason, if you have the opportunity to use the mains, you should always use it. You can eliminate your use of batteries. But if you still need

battery power occasionally, your use of the main on a regular basis will prolong the life of your rechargeable batteries, saving you yet more money, and lessening your personal environmental impact.

In the long term, low-power and highly efficient equipment is the only answer. For example, we could use laptop instead of desktop computers and save a huge amount of energy in the IT industry. But in the home and workplace, more efficient devices have a very positive financial and environmental impact. The ultimate in low-power devices is of course the wind-up appliance. You provide the power so making it, in generation and supply, one of the most efficient methods of powering any electrical device.

Contacts

Catalogue shops, such as Argos or Index, are an easily accessible source of cheap NiCad/NiMH batteries and chargers. But they have limited deals, and do not provide discounts for bulk purchases.

For a better selection of batteries, chargers and power supplies you should instead try one of the mail order electronic component companies. Maplin Electronics have an excellent catalogue that supplies a wide range of appliances, components, batteries, chargers and power supplies. They have an extensive web site at http://www.maplin.co.uk/ or ring customer service on 0870 264 6002 for more details.

If you shop around, via electrical hobbyist magazines or other sources as your guide, you may find better deals on batteries and equipment elsewhere, especially if you are able to buy in bulk with friends.

The Free Range Network is a 'disorganisation' of activists and specialists that organises workshops and develops information resources for community and grass roots campaigning organisations. Free Range Practice Guides are produced on an occasional basis, and are intended to develop the level of practical skill within community organisations.