Energy saving lamp is eco-winner

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In a new study, EMPA researchers have investigated the ecobalances of various household light sources. In doing so not only did they take into account energy consumption, but also the manufacture and disposal processes. They also evaluated usage with different electrical power mixes. The clear winner is the compact fluorescent lamp, commonly known as the energy saving lamp.

Since September 1st, 2009 the sale and import of incandescent light bulbs – more accurately known as tungsten filament bulbs – with the lowest energy efficiency classifications F and G have been banned in Switzerland. In addition, on the same day this country also adopted the EU's incandescent light bulb ban, which legislates for a step-by-step phasing-out of these inefficient light sources. In accordance with the new EU rules, 100 Watt bulbs were banned on September 1st, 2009, and a year later all bulbs rated between 75 and 100 Watts will be withdrawn from the market. After another year's transition period, all bulbs rated above 60 Watts and above will be banned, and then finally, on September 1st, 2012 no more conventional incandescent light bulbs will be allowed to be sold. These regulations have met with resistance from many quarters, with a great deal of criticism being directed at compact fluorescent lamps (CFLs), often called energy saving lamps. One of the main concerns of opponents of these light sources is the fact that they contain mercury.

Roland Hischier, Tobias Welz und Lorenz Hilty, of Empa's "Technology and Society" Laboratory, have examined in detail the different lighting methods currently in use in order to find out which source of

illumination is in actual fact the most environmentally friendly. They investigated four different kinds of lamp; the classical incandescent bulb, halogen lamps, fluorescent tubes and energy saving lamps. In order to evaluate the total effect of a lamp on the environment over its entire life the researchers prepared a life cycle analysis for each kind. This takes into consideration the raw material and energy consumption of a lamp during its complete life cycle, from the production and usage to final disposal. The total ecological burden can, for example, be represented by co-called «eco indicator points» (EIPs). The total point tally is a measure of the sum of all the damage the product in question inflicts on human health and the environment, as well as the usage of resources incurred during its manufacture.

Production and disposal play an insignificant role

The first result the Empa scientists uncovered was that the proportion of the total environmental effects caused by the production of all the lamps was small. Using the Swiss electrical power mix as a basis, the manufacture of an incandescent bulb, for example, was responsible for just one per cent of its total environmental effect. By comparison, the production of an energy saving lamp at 15 per cent of the total is significantly higher, but still negligible. The reason why energy saving lamps have a larger ecological footprint is because of the electronic circuitry they contain. Using the European power mix (which includes a significant fraction of electricity generated by coal fired power stations) as a basis for calculation leads to much lower values for incandescent bulbs and energy saving lamps of 0.3 per cent and four per cent respectively.

The method of disposal of the lamps at the end of their useful life is also not an important factor in the overall ecobalance calculation. In fact, in the case of energy saving lamps the environmental effects reduce by as much as 15 per cent when they are recycled instead of being incinerated.

But even when they are incinerated in a waste disposal facility the much criticized mercury release is quantitatively insignificant. This is because the overwhelming proportion of mercury in the environment is emitted by fossil fuel burning power stations.

The scale of this phenomenon becomes clear by taking a coal-fired power generation plant as an example. Depending on whether it uses brown or anthracite as fuel, a power station emits some 0.042 to 0.045 milligrams of mercury for every kilowatt-hour of energy it produces. A plant generating 1000 megawatts of power therefore releases 42 to 45 grams of mercury into the atmosphere every hour. By comparison, since 2005 compact fluorescent lamps sold in Europe may contain a maximum of only 5 milligram of mercury. In other words, a coal fired power station emits the same quantity of mercury every hour as is contained in 8400 to 9000 energy saving lamps.

It all depends on the use

By far the greatest environmental effects are caused by actually using the lamps. An important factor here is the source of power used, since an incandescent lamp run on electricity generated by a hydroelectric plant is less polluting than an energy saving lamp running on the European power mix. "By choosing to power lamps with electricity generated in an environmentally friendly way one can achieve more in ecological terms than by simply replacing incandescent bulbs with compact fluorescent lamps," clarifies Roland Hischier.

But energy saving lamps do have an ecological advantage. This is shown by the determination of the «environmental break-even point», which is the time for which a lamp operates in order to inflict a certain degree of total environmental damage. Using the European power mix, which is produced mainly by fossil fuel powered generation plants, both incandescent lamps and energy saving lamps reach their environmental

break-even points very quickly - after some 50 hours - due to the significantly higher power consumption of the tungsten filament bulb. With the Swiss power mix this point is reached after 187 hours. But with a typical lifetime of about 10,000 hours for a compact fluorescent energy saving lamp (compared to some 1000 hours for an incandescent bulb), the purchase of such a lamp pays for itself very quickly in an ecological sense.

More information: "Environmental impacts of lighting technologies – Life cycle assessment and sensitivity analysis," T. Welz, R. Hischier, L. Hilty, *Environmental Impact Assessment Review*, published online on October 12th, 2010, www.elsevier.com/wps/find/jour … cription#description

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