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PHYSICS IN DAILY LIFE:

NEW LIGHT

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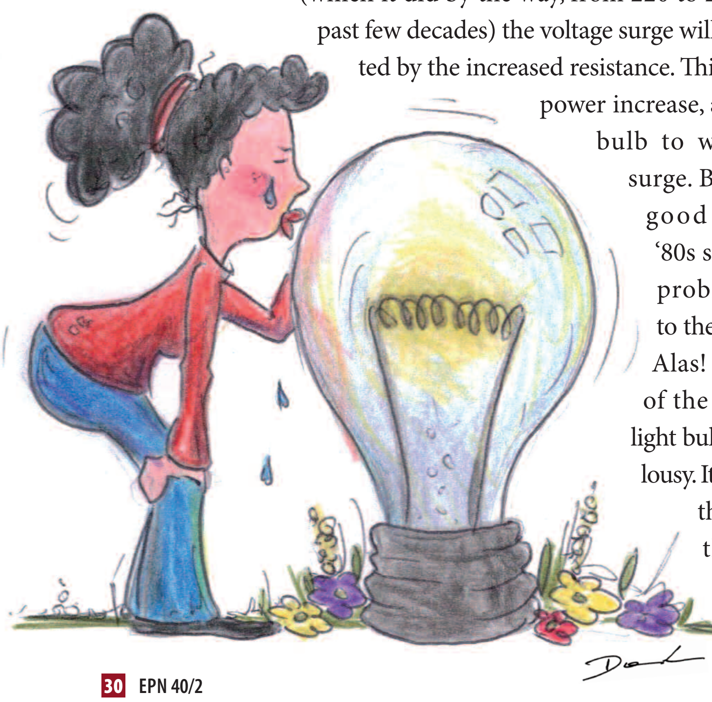
The old-fashioned incandescent light bulb with its Tungsten filament is a marvellous piece of technology. If we switch it on, it needs only a split second to light up our office, our home or our fridge. Sure, this instant reaction is largely due to the low heat capacity of the filament. But there is more to it than most of us realize: Tungsten, like all ordinary metals, has a positive temperature coefficient. Indeed, if we calculate the resistance from the bulb's power and the grid voltage, and compare it with a direct measurement at ambient temperature, we find that the hot filament has a larger resistance by a factor of 20 or so. This means that, if we switch the bulb on, the initial power is very high, making the bulb rush to its operating temperature in no time at all. And the other nice thing is: should the voltage go up for some reason (which it did by the way, from 220 to 230 V over the past few decades) the voltage surge will be counteracted by the increased resistance. This dampens the power increase, and allows the bulb to withstand the surge. Bulbs from the good old '70s or '80s should have no problem adapting to the 21st century.



Alas! The efficiency of the incandescent light bulb is downright lousy. It is so poor, that the members of the European Parliament recently decided to ban the bulb. They have a point. There is no way we can ever make a glowing piece of Tungsten into an efficient light source. For one thing: the emission peak at 3000 K is around 1 μm wavelength, as follows directly from Wien's law. The corresponding emission curve has only a small overlap with our eye's narrow sensitivity curve at around 0,5 μm. And if we go much higher than 3000 K, the filament won't last very long. By invoking halogen vapour to redeposit evaporated Tungsten back onto the filament, we may get a bit closer to the melting point of 3700 K. But even if we were able to find a high-melting-point metal which could be heated to 6000 K (roughly the effective solar temperature, with an emission peak that nicely fits our eye sensitivity), its black-body radiation curve would still be much broader than the eye sensitivity curve, with a lot of energy wasted.

What we need is a smart light source which selectively emits radiation that our eyes can see. And which has no filament that slowly but surely evaporates.

So we turned to gas discharge and invented fluorescent TL lighting long ago, with an efficiency of 100 lumen per watt, and – more recently – its folded version known as the energy saving lamp, reaching 50 lm/W. And, of course, the Light Emitting Diode as its solid-state counterpart, with a similar efficiency, depending on the type. Compare this to a poor 12 lm/W for the good old incandescent bulb!

We may not always be happy with politics: when it comes to lighting, however, we have to admit that 'Brussels' has a point. Incandescent light bulbs may be fast and convenient. Their emission spectrum may be nice and continuous. But in terms of efficiency, they are beyond hope. It's about time to kiss that bulb goodbye. ■