

The wonderful thing about TIG rods

...is that some types can be used as low-risk radioactive sources for certain experiments and demonstrations. Here we look at what TIG rods are, how to handle them safely and what uses they can be put to.



Figure 1 - thoriated TIG welding rod, as supplied with the Lascells cloud chamber.

What are TIG rods?

Tungsten Inert Gas (TIG) welding is a form of arc welding. To improve the quality of weld and to make the welding process easier, thorium is sometimes added to the electrode when it is manufactured. A typical thoriated electrode will contain around 2% thorium by mass. The TIG electrode is consumed in the welding process but the material does not form part of the weld. Nevertheless, these electrodes are usually referred to as TIG welding rods.

Thorium is radioactive. A thoriated TIG welding rod will emit alpha, beta and gamma radiation from the thorium and its decay products. The activity of a rod will be around 3 to 7 kBq. Sealed radioactive sources used in schools typically have activities of 70-370 kBq and are designed to emit predominantly one form of radiation.

How do I use them safely (and legally)?

Thoriated TIG welding rods are not subject to much of the legislation that covers radioactive sources in schools. Care must still be taken when using them. Here is some guidance. Please note that were you to weld with a thoriated TIG rod, the control measures would be very different.

- Do not saw, grind or file a thoriated TIG welding rod. These actions will produce small particles containing thorium. The thorium could be inhaled, ingested or could enter the body through a wound.
- Keep the rods in your radioactivity store if you have one and add them to your inventory. If you don't have a radioactivity store, at least ensure they are labelled as "thoriated TIG rods". There is no need to use the ionising radiation warning symbol.

Rods can be handled without protective equipment. The dose rate to a part of the body touching a TIG rod is about four times that of background radiation and it drops rapidly with distance. Clothing will shield you from the alpha radiation. You could walk around with a thoriated TIG welding rod in your pocket for hundreds of hours in a year before receiving the 10 microSievert dose considered to be negligible by the International Commission on Radiological Protection.

What can they be used for?

The electronically-cooled Lascells cloud chamber that SSERC put into each local authority in 2015 [1] uses a thoriated TIG welding rod as a source. As it emits heavily-ionising alpha radiation, it is ideal for producing strongly-visible tracks. If you have an older cloud chamber that came with a radium source, that source should have been disposed of by now. A thoriated TIG welding rod makes an excellent substitute.

If you are running the *National 5 Skills for Work – Laboratory Science* course, you will know that students are required to measure radiation. They cannot use the majority of school sources if there are any under-sixteens in the room. SSERC has suggested using potassium compounds or carrying out the radon balloon experiment. Using thoriated TIG rods is another age-unrestricted activity. With the rod a few mm from the end of our Geiger-Müller tube, we measured a count roughly four times that of background alone.

Finally, it is good to be able to show that some objects happen to be radioactive, not because they require to be but due to the presence of a radioactive substance that has some other useful property. Low sodium salt is one example. It contains potassium chloride, which is mildly radioactive. The radioactivity confers no health benefits but neither does it pose a risk sufficiently large to negate the positive effects of reducing sodium in one's diet by using low salt.

Thorium-free thoriated TIG rods

Cerium oxide or lanthanum can be used as substitutes for thorium in TIG rods. We know of some schools who have bought welding rods marketed as "thoriated", only to find that there is no detectable radiation above background level from the rods. We suggest buying "over the counter" where possible. <<

Reference

- [1] https://www.sserc.org.uk/wp-content/uploads/2015/05/SSERC251_p2.pdf (accessed May 2019).

Welding in schools

The Health and Safety Executive has recently announced that it has raised the control standards for welding fumes to now include the welding of mild steel.

New scientific evidence has been published that indicates that exposure to mild steel welding fume can cause lung cancer and possibly kidney cancer in humans. Based on this scientific evidence the HSE have strengthened their “enforcement expectation” on all types of welding fume. It is now no longer deemed adequate to weld mild steel in just a well-ventilated area as it does not achieve the necessary level of control.

So how does this relate to welding in the school craft room?

Well, as with all HSE regulations this “enforcement expectation” also applies to all educational establishments with immediate effect. All welding fume is now classed as carcinogenic. Regardless of welding duration, any welding done without suitable exposure control measures in place will not be acceptable.



Figure 2 - Portable style Extraction Unit.



Figure 1 - Welding booth showing movable extraction arm/hood.

So what control measures should be in place?

Any welding tasks undertaken indoors will require suitable engineering controls to be employed such as Local Exhaust Ventilation (LEV). A typical school setup like figure one would be expected. It should be noted that with this type of extraction (a flexible arm and capture hood) it must be positioned as close as practically possible to the weld area in order to provide effective extraction.

This type of LEV system must be suitably maintained and is subject to a thorough examination and test every 14 months.

If the LEV system employed alone does not adequately control exposure risk, it must be supplemented with suitable respiratory protective equipment (RPE) such as an FFP2 classed mask as a minimum or better still and FFP3 mask. Any welding done outdoors will require the use of RPE.

Other types of welding extraction available include those similar to the one shown in Figure 2. This type of “portable” extraction system uses series of internal filters to capture harmful fumes before recirculating the air back into the room.

It should be highlighted that Risk Assessments should reflect this change and the necessary control measures be taken. The HSE have advised that they will be updating their guidance on welding mild steel as soon as possible. SSERC will also be updating the model welding risk assessment.



Sodium in water incident

An incident has come to our attention that merits wider circulation.

One method of carrying out the alkali metal in water reaction is to place a perspex sheet flat on the top of the basin of water, rather than using safety screens set up vertically around the trough.

In general, there seems to be no problem with this method. However, recently a teacher, having carried out the experiment once did it again shortly after, just moving the cover enough to allow the fresh piece of sodium to be dropped in.

The spark as the sodium came in contact with the water was enough to ignite the hydrogen air mixture that had been produced by the previous batch and a jet of flame shot out of the narrow opening, burning the teacher. Fortunately, not causing major injury.

The lesson to be learned here is that if you are using this method, remove the covering completely for a few seconds before a repeat experiment to allow the hydrogen to disperse. <<

Everybody needs good NEBOSH

SSERC's chemistry specialist Chris Lloyd has become the latest member of the organisation to gain the NEBOSH National Diploma in Occupational Health and Safety. This is a major achievement as the qualification involves extensive studying, exams and the submission of a lengthy dissertation.

The Diploma is evidence of a deep understanding of Occupational Health and Safety. Having staff who hold this qualification is of great benefit to SSERC and to our members. It is the gateway to Chris attaining Chartered Membership of IoSH, another certification that is highly regarded by those in the health and safety community. <<

