

Occupational Thorium Exposure or Self-Poisoning?

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Introduction

Thoriated electrodes are used in TIG (Tungsten Inert Gas) welding [1]. Thorium intake may happen during grinding and welding operations using thoriated electrodes [2]. The use of thoriated tungsten electrodes may be at the origin of a potential hazard [3]. The annual committed effective dose from inhalation of ²³²Th, ²³⁰Th, ²²⁸Th and ²²⁸Ra is usually below 1mSv for a full-time TIG welder [4]. Electrode consumption during welding was primarily the result of tip sharpening. Indeed, less than 3% of weight loss was attributable to the welding process [5].

Considerable intake can happen during alternating-current welding and also electrode grinding, if suction systems are not used [1]. However, neither excess of morbidity nor mortality was found among the TIG or non-TIG welding group [6]. In the worst case, the annual limit on intake of thorium derived from the most recent ICRP publications was exceeded by a factor of 10 [1].

Case Report

A 60 year old retired welder has referred to an occupational diseases department to investigate his past exposure to thorium. During the medical examination, he indicated being afraid of his occupational thorium exposure, but he has no symptom. He has decided to wear a personal dosimeter at work for the last years of work. He worked during 5 years as a shoemaker, then for the next 5 years as a farm technician. He was engaged as a welder for the last 34 years. He used 3 processes successively: soldering, arc welding, and TIG welding (during respectively 20%, 40%, and 40% of his working time). He welded pipes and mechanical devices for food industry. He worked either outdoor or in a workshop, and also sometimes in narrow non-ventilated spaces. He mainly welded steel and stainless steel but also bronze, copper, and titanium. He employed solvents too, such as toluene and trichloroethylene. The consumption of thorium was evaluated to a half kilogram during his entire career (He used TIG welding during 25 years, for a 37 years career as a welder). Moreover, he casually makes his own ammunitions for shooting, and he drinks water filtered through a self-made filter. Thorium takes several years to be eliminated (14 to 20 years). We assessed the Thorium body accumulation through urine sample.

The data obtained were significantly above upper limits (Table 1). Complimentary explorations were prescribed including Thorium dosing in stool sample, and again in urine sample. It was also required to perform an anthropogammametry.

The patient refused to have further investigations.

Thorium Measurement	Case (mBq/l)	upper limit (mBq/l)	By day (mBq/24h)	Case/limit ratio	Natural Th (mBq/l)
²³⁸ Th	314.8	13.8	645.3	22.8	0
²⁰³ Th	13.4	2.8	28.1	4.8	0
²³² Th	127	8.3	261	15.3	0.3

Table 1: Thorium dosing in urine sample.

Discussion

We know that elevated Thorium assessments can only occur during a huge exposition while TIG soldering. This welder is retired for one year; moreover he used to weld less than half of his working time using TIG method.

Few studies led to assess Thorium levels, while TIG soldering, conclude that internal radiation doses were less than an annual level of intake [4,6]. However it doesn't exclude the occurrence of toxic Thorium levels under different welding conditions. In working conditions, as described by the patient, such a high occupational Thorium exposure is unlikely. Such measurements could happen if samples are contaminated. We can imagine that he voluntarily contaminated his urine sample by soaking thoriated electrodes in it. Indeed, an alpha removable contamination was described by Laroche and Col [3]. But in this case, even higher measurements would be obtained.

Actually, self-poisoning can produce such measurements. For example, he may have voluntarily breathed thoriated electrodes grinding dust. This patient's behaviour strengthens this hypothesis: his speech was weird, paranoid. He wrote several long letters describing how the society used him as a subject of experimentation, how his co-workers and he were poisoned, and why he has to react. He finally wrote that his actual concern was Argon gas suffocation, and then he was lost to follow-up.

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