

THORIUM EXPOSURE DURING WELDING AND GRINDING WITH THORIATED TUNGSTEN ELECTRODES

T. Ludwig, G. Seitz

Berufsgenossenschaft der Feinmechanik und Elektrotechnik, Köln, Germany

ABSTRACT

Applying Tungsten Inert Gas (TIG) shielded welding process, often thoriated tungsten electrodes are used. Thorium is added to facilitate arc starting and to increase the arc's stability. If the electrode is touched down on the workpiece - not standing for a proper use but not always to avoid - a part of it will be vaporised. In the course of this, Thorium will be emitted. Only a sharp electrode will guaranty the wanted quality. Therefore the welder had to grind the electrode from time to time, also emitting Thorium in breathable form.

The presented contribution gives an overview about the results of numerous personal measurements of airborne activity concentration during grinding and welding.

Under proper use of thoriated electrodes at welding airborne activity (Th-232) of up to 2.6 mBq/m³ were found. This leads to an maximum annual body burden of 1.5 Bq. This is far below the limits of German regulations of non radiation workers. During grinding activity concentrations up to 0.5 Bq/m³ were measured. Even taking realistic annual working time into account limit may be exceeded. Radiation protection measures are to be enhanced, suggestions are made.

MATERIALS AND METHODS

Breath samplings had been taken in 19 plants under realistic conditions. Samplings during grinding were taken near breath openings of the patient (fig. 1/2). For the welding measurements a modified protective shield had been used, so that samplings could be taken beyond the shield in welders breath area (fig. 3). With the known volume rate and the sampling time the sampled volume could be calculated.



Fig. 1: Dust sampling during grinding



Fig. 2: Personal dust sampler



Fig. 3: Dust sampling during welding

ANALYSING FILTER SAMPLINGS

Expecting enough activity on that samplings, taken during grinding, these filter samplings were analysed by direct alpha spectrometry. The detection limit of this method (10 mBq Th-232 per Filter) was low enough therefore. These samplings were analysed by BIA.¹⁾

The total activity on the welding filter samplings were far below the detection limit of alpha spectrometry. Therefore these samplings were analysed by gamma spectrometry after neutron activation. With this method a detection limit of about 0.1 mBq Th-232 per filter could be reached.

RESULTS

In table 1 the results of welding measurements are presented. The mean value (without measurement no. 1) of activity concentration is about 0.5 mBq/m³. The result of measurement no. 1 does not fit the other values. In this case, the welder continual touched down the electrode on the workpiece not in proper use.

The average of yearly inhaled activity by welding - based on realistic working time in the involved plants - is nearly 500 mBq/y.

measure no.	working time per year [h]	volume (m ³)	Th-232 activity per filter (mBq)	activity concentration mBq/m ³	yearly inhaled activity (Bq/a)
1	1760	0,945	22,0	23,3	49,2
2	2000	0,63	< 0,28	< 0,44	< 1,1
3	300	1,26	0,24	0,2	0,07
4	960	1,26	0,24	0,2	0,2
5	880	1,26	0,12	0,1	0,1
6	2000	1,26	< 0,13	< 0,1	< 0,24
7	1440	0,882	0,24	0,3	0,5
8	1320	0,945	0,33	0,35	0,6
9	840	1,103	0,49	0,44	0,4
10	1020	0,42	0,49	1,2	1,5
11	480	1,103	< 0,19	< 0,17	< 0,1
12	1200	1,26	< 0,21	< 0,17	< 0,3
13	480	1,26	< 0,21	< 0,17	< 0,1
14	480	1,05	2,72	2,6	1,5
15	1760	1,05	< 0,23	< 0,22	< 0,5
16	30	1,26	0,23	0,18	0,01
17	960	1,26	1,18	0,94	1,1
18	1740	1,26	< 0,21	< 0,17	< 0,4
19	1920	1,211	< 0,24	< 0,2	< 0,5

Tab. 1: Results of measurements during welding with thoriated tungsten electrodes

Table 2 shows the preliminary results - for the influence of some parameters the discussion is still going on - of the measurements during grinding the electrodes. The alpha spectrometry analyses shows, that the Th-230 activity of the used electrodes was clear below 20 % of the Th-232 activity.

In most cases no technical ventilation is used on the wheel stand. The mean value of inhaled activity per single grinding is 4.5 mBq (measurement no. 3 and no. 19 omitted).

¹⁾ H. Siekmann, D. Schwaß, Berufsgenossenschaftliches Institut für Arbeitssicherheit, St. Augustin, Germany

measure no.	number of yearly grindings	volume (m ³)	inhaled Th-232-activity per grinding (mBq)	activity concentration (mBq/m ³)	yearly inhaled activity (Bq/a)
1	7820	0.21	3.86	177	30.18
3	900	0.21	0.05	2.4	0.05
5	320	0.21	0.87	40	0.28
12	1680	0.21	2.34	109	3.93
15	700	0.21	15.04	514	10.53
16	50	0.21	2.62	153	0.13
17	320	0.21	6.00	275	1.92
18	580	0.21	0.55	69	0.32
19	45000	0.11	0.06	1.8	2.70

Tab. 2: Selected results of measurements during grinding of thoriated tungsten electrodes, no. 3 and no. 19 were sampled with technical ventilation in use, all others without ventilation

DISCUSSION

Welding: While recently a possible hazard through inhaled Thorium during welding is reported [1], these measurements seem to confirm with other literature [2,3] which show Thorium exposure during welding well below of the annual limit of intake. The estimated maximum value of yearly inhaled activity (1.5 Bq/y) is below the German limit for non radiation workers (6 Bq/y). Of course a longer yearly welding time could lead to an exposure reaching the limit. Improper use of the electrodes (measurement no. 1) could exceed the limit. So the ALARA principle should be taken into account and the possible incorporation should be reduced through technical ventilation during welding.

Grinding: Two of the grinding results are above the limit. With the determined average value of inhaled activity per grinding (4.5 mBq) more than 1350 grindings per year - corresponding to 6 grindings per day - could lead to an intake above the limit. Especially if one person grinds the electrodes for a number of welders (case no. 19 e. g.) this could be a problem if no technical ventilation is used.

For grinding thoriated tungsten electrodes the use of technical ventilation on the wheel stand is therefore always recommended. When cleaning the waste box of the wheel stand, breath protective equipment should be used.

ACKNOWLEDGEMENTS

The authors would like to thank the involved industrial injuries insurance institutes, the Norddeutsche Metall BG and the Maschinenbau und Metall BG for additional samplings. They also are grateful to the BIA for alpha spectrometry measurements of the grinding samplings.

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