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AIR MONITORING DURING FIRST URANIUM-STEEL PRODUCTION AT ATLAS STEELS LTD., MAY 17-19, 1961

by

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MINERAL SCIENCES DIVISION

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SUMMARY OF RESULTS

Air samples were taken during the melting and pouring of six 500 lb heats of uranium-bearing steel containing varying amounts of uranium. The concentrations of uranium in air were found to be well below the maximum permissible level. A brief check during grinding operations on one uranium-containing ingot showed a rather high concentration of uranium in air, necessitating the wearing of face masks for this work.

Additional radiometric surveys were done to check the uniformity of distribution of the uranium in the ingots and the activity of the slag.

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INTRODUCTION

On May 17-19, 1961, Atlas Steels Ltd. conducted its first tests on the production of uranium-bearing alloy steels at its Welland, Ont. plant. As this work was done under AECB Licence 92/25/61, dated February 28, 1961, issued to the Mines Branch, the writers accompanied Mr. R.D. McDonald of the Physical Metallurgy Division to observe the melting of the steels and subsequent handling and to obtain airborne dust samples to demonstrate whether or not any difficulties would be encountered in meeting permitted maximum concentrations of uranium in air. The actual production of the heats was supervised by Mr. E.G. Schempp of Atlas Steels. Dr. A. Schmidt of the Ontario Department of Health appeared briefly on May 17 to reassure himself of the safety of the operations.

DETAILS OF THE TEST WORK

The operations consisted of the melting and pouring of eight heats of 500 lb each, which were melted in a high frequency induction furnace. Of these heats, two heats were Atlas Steels "Vibresist" (heats G 697 and 698) and six heats were Stainless type 430 (heats G 699 - G 704). Heat G 701 was a comparison heat, containing no uranium; heat G 697 was termed a wash heat.

Metallurgical details have been given by Mr. R.D. McDonald in his report, PM-V-61-9.

For reference the crucial constituents only are listed, as observed by the Company, together with the pouring times.

TABLE 1

Details of Heats

Heat	Time of pouring	U %	Ti %	Cb %	Cr %	C %
G 697	11:57 am, May 17	0.07	-	-	1.38	0.96
G 698	2:29 pm, "	0.06	-	-	1.1	0.92
G 699	11:01 am, May 18	0.39	0.11	-	16.94	0.06
G 700	1:19 pm, "	0.06	0.12	-	17.17	0.06
G 701	3:08 pm, "	-	0.13	-	17.45	0.06
G 702	10:37 am, May 19	0.07	-	0.74	17.28	0.055
G 703	not observed	0.05	-	0.70	17.18	0.06
G 704	not observed	0.06	0.23	-	17.02	0.055

The last two heats were not monitored as they did not present any new features.

Film badges were issued to Mr. E.G. Schempp, who acted as melter, and Mr. D. Boyd, his assistant. The film badges were worn for 50 hours. Before the start of the work the drums of ferro-uranium master alloy were monitored with a survey meter in the caged-off area where they were stored.

On May 19, air samples were also collected during hand grinding of the ingot obtained in heat G 699, with the highest uranium content. This test was complicated by the fact that part of the plant is still wired for 25 cycles only.

TEST RESULTS

A. Survey of Master Alloy

Two hundred pounds of master alloy were stored in three drums in a separate area. The dosage reading for all three drums together reached a maximum of 1.2 milliroentgens per hour (mr/hr) in the middle between them, well below the maximum permissible level for 40 hour/week exposure. The reading on the top of each drum was 0.4 mr/hr.

B. Filter Results

Details of the air samples collected and the uranium assays obtained are presented in Table 2. The only filters showing sizable amounts of uranium are No. 15, obtained after heat G 702, when some frozen metal had to be chipped out of the furnace, and No. 16, during the grinding of the high-uranium ingot from G 699. Filter No. 15 does not indicate uranium levels above the permissible concentration of 5.6 μg U/cu ft. No. 16, however, indicated double the permissible value. In this case the work was of short duration only, and hence the actual dosage per 40 hour week was well below the permissible value.

TABLE 2

Air Monitor Samples

Filter No.	Location	Time	Exposure time	Approx. Volume sampled (cu ft)	Net count rate after three days (c/m)	Total uranium (µg)	Air concentration (µg U/cu ft)
1	3 ft from furnace during heating of G 697	11:00 - 11:45 am	45 min	2110	Bgd	-	-
2	3 ft from furnace on boom during pouring of G 697	11:57 - 12:06 pm	9 min	440	Bgd	-	-
3	Edge of platform above cooling ingot mould	12:13 - 1:30	77 min	4235	2.7	58 (calc)	0.014
4	3 ft from furnace during heating of G 698	1:35 - 2:25	50 min	2400	Bgd	-	-
5	as for #2, during pouring of G 698	2:29 - 2:35	6 min	285	Bgd	-	-
6	Edge of platform during cleaning of furnace	2:44 - 3:00	16 min	865	Bgd	-	-
7	On stand 7 ft from top of furnace during heating of G 699	8:40 - 9:40 am	60 min	3180	Bgd	-	-
8	Suspended from guard rail 4 ft from furnace, in fume stream; during pouring of G 699	10:55 - 11:07	12 min	575	7.9	325 (chem)	0.65
9	as for #3	11:09 - 12:09	60 min	2950	14.5	228 (chem)	0.077
10	as for #8 during pouring of G 700	1:19 - 1:30 pm	11 min	530	2.5	53 (calc)	0.10
11	as for #3	1:35 - 2:35	60 min	3000	10.7	228 (calc)	0.076
12	as for #8 during pouring of G 701 (no uranium)	3:08 - 3:22	14 min	675	2.3	49 (calc)	0.073
13	On platform during heating of G 702	9:34 - 10:16 am	42 min	2020	1.2	26 (calc)	0.013
14	as for #8 during pouring of G 702	10:37 - 10:47	10 min	480	3.8	81 (calc)	0.17
15	as for #3 during cooling of of ingot and cleaning of furnace	10:55 - 12:00	65 min	2600	172.3	2700 (chem)	1.04
16	Close to operator during grinding of ingot from G 699	11:25 - 11:30	5 min	230	100.4	2568 (chem)	11.2

Background count rate 12-14 counts/minute (Bgd)
Chemical assays obtained fluorimetrically by J.B. Zimmerman, Extraction Metallurgy Division.
Calculated values based on mean ratio of count rate/chemical assay.

C. Film Badges

The film badges were sent to the Department of National Health and Welfare for development. Neither film badge indicated any reportable exposure to radiation.

SURVEY OF INGOTS

As a check on the uniformity of distribution of the uranium in the ingots, a portable Geiger counter was used to survey the beta radiation from the surface of two ingots after cooling. In addition a small billet made at the Mines Branch (#4662) was also surveyed for comparison. Readings were taken at 2 inch intervals and are listed in Table 3.

TABLE 3

Survey Results on Ingots

Ingot G 699			Ingot G 700		
Position	Marked face (c/m)	Left face (c/m)	Position	Marked face (c/m)	Right face (c/m)
Top end	50000	-	Top end	29000	-
1	8000	4650	1	2350	2200
2 (rough edge)	4600	8500	2 (rough edge)	2900	3300
3 (main body)	4800	10000	3 (main body)	2600	3100
4	4300	2600	4	1850	1500
5	4200	1900	5	1000	870
6	2960	1750	6	600	750
7	2400	1400	7	550	710
8	2000	1600	8	520	740
9	1860	1700	9	340	790
10 (bottom shoulder)	1250	1800	10	330	390
11	1050	1600	11 (tip)	330	390
12 (bottom)	1100				

Billet #4662	
Position	Marked face (c/m)
Top end	50000
1 (near top)	18000
2	19500
3 (main body)	18500
4	16500
5	17000
6	16500
7	17000
8	17000
9	17000
10 (bottom end)	

It is evident that the Mines Branch billet was much more uniform in uranium distribution than the Atlas ingots.

RADIOMETRIC ASSAYS ON SLAG SAMPLES

Two slag samples were taken back to Ottawa for radiometric assays to estimate uranium losses to the slag. No material balance was attempted as there was no record of the total weight of slag. The radiometric results are, therefore, tabulated for the record only. The samples were crushed in a jaw crusher, but this did not reduce the particle size sufficiently to produce a smooth surface for assaying. A hand magnet was used to separate a magnetic and a non-magnetic fraction. Table 4 lists the results obtained in the standard beta-gamma assay unit.

TABLE 4

Slag Assays

Sample	Fraction	Weight (g)	Net gamma counts (c/m/g)	Net beta counts (c/m)
430 Stainless - A	non-magnetic	98	108.4	33,766
" - B	"	101	113.2	33,280
" - C	"	90	112.4	33,184
" - D	"	101	118.4	33,344
"	magnetic	65	67.3	17,779
Vibresist-G 698-A	non-magnetic	72	57.6	12,557
" -B	"	68	49.4	12,995
" -C	"	73	52.4	13,904
"	magnetic	40	19.2	4,110

CONCLUSIONS

The heats involved in this work were relatively small and the uranium content low. The concentration of uranium in air was low in all cases and well below the maximum permissible level. In the case of the grinding operation the uranium level was uncomfortably high, although not hazardous in view of the short duration of the test. The grinder operator wore a face shield, but for extensive work involving the grinding of uranium-bearing steel with high uranium content the wearing of a respirator-type face mask is strongly recommended.

The writers are grateful to Mr. E.G. Schempp for his friendly cooperation.

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