

**International Workshop on
Environmental Aspects of Coal Ash Utilization**

Tel Aviv, Israel
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**Monitoring Trace Elements in Coal Ash,
a Background Document**

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Abstract

According to the "Environmental Damages Prevention Plans" of the two coal-fired power stations "Orot-Rabin" and "Rutenberg", issued as parts of their operation licenses, IEC performs a follow-up of trace elements concentrations for coal burnt and for the two kinds of coal ash produced (fly ash and bottom ash) in the power stations. For this purpose, composite samples representing six-month periods of the power stations activities are prepared by the IEC laboratories and sent to the Israel Geological Survey geochemistry laboratory for the analysis of 16 trace elements. Updated tables are prepared and reported to the concerned Authorities, and include the results obtained for the two last samples, together with the range and the average concentrations of the trace element concentrations (see in appendix updated table for fly ash). The quality of coal ash is well characterized using composite samples, as they reflect the composition of ash obtained from a mixture of different coal sources, like coal ash sent to utilization from piles at the storage sites of the power stations. In view of the long periods covered (from 1986 until to date for "Orot-Rabin" power station, from 1991 until to date for "Rutenberg" power station), this data basis allows to characterize the coal and ash composition with a high level of reliability.

The "Environmental Guidelines for the Utilization and Handling of Coal Ash" issued in 1998 by the Ministry of Environmental Protection introduced an additional request, monitoring of the trace elements in leachates of fly ash. In these guidelines, the Ministry of Environmental Protection adopted as leaching test the Toxicity Characteristic Leaching Procedure – TCLP, recommended by the USEPA, and set also leachate interpretation criteria. These criteria, specific for Israel, are thresholds of the concentrations of 10 trace elements in leachates, below which fly ash is defined as "utilizable". The monitoring of trace elements in the leachate improves the environmental characterization of fly ash, since trace elements concentrations in leachates suit better than the total trace elements concentrations in the solid to predict the potential effects of the ash on groundwater quality in open applications (e.g. road construction). Since July 1998, the TCLP leaching test was added to the analyses performed on the 6-month composite samples of fly ash produced at both power stations. According to the summary of the TCLP leachate analyses performed during the period 7/98 – 6/09, all the fly ash produced by IEC is conform to the criteria defining it as "utilizable".

In order to get a still finer characterization of coal ash, with regards to trace elements, and to detect eventual differences between ashes obtained from coals originating from different countries and from different mines for a given country, another data basis

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was created using the results of trace element analyses performed on fly ash samples produced from the different coals. For that purpose, analyses were performed on "industrial ash" samples, fly ash produced from a specific coal. With this data basis, which is constantly updated, information is available on trace elements concentrations - total concentrations and TCLP leachate composition - for nearly all the kinds of coal supplied to IEC. On the basis of the results, there are only limited variations in trace elements concentrations for coals originating from different places. For each trace element, averages and ranges obtained for the trace elements concentrations for the 6-month composite samples and these obtained for "industrial ash" samples are roughly similar.

In the process of purchasing new kinds of coals the environmental quality of the coal is taken in account. The specifications of the coal imported to Israel are these of a typically low-sulfur bituminous coal. Most of IEC electricity production units are operated without Flue Gas Desulfurization, thus the sulfur content in the coal imported needs to be in the low range found in coals available on the world market, to respect the regulatory limits imposed on SO₂ emission to the air. As reported in the literature, for most trace elements, there is a good correlation between concentrations of trace elements and sulfur in coal. Thus the purchase of low-sulfur coal ensures that new coals contain low concentrations of trace elements. Furthermore, when a new kind of coal is proposed, its purchase is validated by IEC only after that the trace elements concentrations were checked either in a sample of laboratory ash or in a sample of industrial ash obtained when coal from the trial shipment is burnt at the power station. IEC gives its final agreement to purchase the coal proposed, if the trace elements concentrations found in the ash are included in the ranges observed in the past in fly ash produced by the power stations and if the TCLP results are conform to the "utilizable" ash criteria.

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Trace element concentrations in fly ash produced at the IEC power stations

Data given in ppm on dry basis

Element	Orot-Rabin A Power Station			Orot-Rabin B Power Station			Rutenberg Power Station			General / IEC	
	7-12/08	1-6/09	Average	7-12/08	1-6/09	Average	7-12/08	1-6/09	Average	Range	Average
As	24	20	23	24	9	16	24	23	26	9-60	22
B	320	250	245	300	130	211	260	315	245	75-550	235
Ba	1350	1750	1907	2500	1320	1879	1000	1240	1684	1000-3075	1818
Be	6	8	8.3	9	6	10	7	7	10	5.0-13.0	9
Cd	0.4	0.9	0.9	0.6	0.2	0.6	0.5	0.6	0.9	0.2-1.5	0.8
Co	32	45	40	40	26	41	39	35	44	10-76	42
Cr	100	145	138	125	80	132	120	135	143	80-205	138
Cu	64	74	73	75	48	70	58	62	77	48-110	74
Hg	0.07	0.07	0.13	0.07	0.07	0.14	0.12	0.11	0.18	<0.02-0.30	0.15
Mn	355	380	352	405	260	361	325	360	380	218-558	365
Mo	11	9	15	9	6	9	9	9	12	6-26	12
Ni	75	95	89	80	55	85	90	88	99	55-240	92
Pb	32	46	52	50	29	50	31	31	64	29-140	56
Sb	4	2	5	3	2	3	3	2	4	1-9	4
Se	5	5	7	<2	3	5	5	8	9	1-24	7
V	155	170	187	195	100	169	175	195	218	100-455	193
Zn	115	160	115	155	80	106	110	120	134	65-190	119

Averages and range for the 1/91-6/09 period