

# **Jisr – El – Zarka**

**Summary of ten years  
monitoring**

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**This presentation is based on the following works :**

**Reports of the Geological Survey of Israel.  
(Yoetz Deutsch, Dr. Olga Yoffe, Dov Levite)**

**Reports of the Volcani Institute.  
(Prof. Rami Keren, Dr. Menahem Ben-Hur)**

**Reports of the Israeli Electric Company  
(Compilations of works by scientists of Volcani  
Institute and the Geological Survey by Dr. Ariel  
Metzger)**

**In 1997, it was decided to build a new access road to the small town of Jisr el Zarka.**

**This road of about 1.1 km in length from south to north, east of the Tel-Aviv – Haifa highway, joins the old access road to the new bridge built over the Tel Aviv – Haifa highway. The access is now to the northern quarters of Jisr.**

**This was an opportunity to experiment the use of coal ash as a structural fill for the Jisr road and bridge.**

**Some 28,000 tons of ash were used; half of the amount was bottom ash, used for the road (southern part) and half was fly ash used for the northern part (road and bridge). Some soil was also used as fill for the road in the southern part.**

**Since the use of coal ash, specially fly ash, is considered to have a pollution potential to aquifers, the Ministry of Environment agreed to the experiment conditional to a long-term monitoring program.**



הים התיכון  
(Mediterranean Sea)

ג'סר - א - זרקא  
(Jisr el-Zarka)

קיסריה  
(Cesarea)

סוללת הגשר  
Bridge )  
(Embankment

סוללת הכביש  
Road )  
(Embankment

700 meter

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# **Groundwater monitoring**

**The coastal aquifer, the only aquifer which may be affected by the coal ash, is very shallow in the Jisr area. The direction of flow is south-east – north-west. The monitoring was done in two boreholes, in the coastal aquifer, close to the new road. One was drilled specially for this project, G/1, situated a few meters to the west of the road. Any leaching of the ash will reach this borehole.**

**The other T/3 is a borehole to the east of the road. This is one of the boreholes which are regularly monitored by the Hydrological Survey. This borehole was used as a control borehole since no leachate from the ash could reach it.**

**Comparison of the analyses of boreholes T/3 and G/1 from the sampling on 7/6/98<sup>1</sup> and on 13/12/00<sup>2</sup>. The results are given in ppb.**

	<b>As</b>	<b>Ba</b>	<b>B</b>	<b>Cd</b>	<b>Cr</b>	<b>Hg</b>	<b>Pb</b>	<b>Se*</b>	<b>Zn</b>
<b>T/3<sup>1</sup></b>	<b>4</b>	<b>52</b>	<b>270</b>	<b>0.15</b>	<b>20</b>	<b>0.3</b>	<b>0.5</b>	<b>21</b>	<b>100</b>
<b>G/1<sup>1</sup></b>	<b>4.5</b>	<b>50</b>	<b>380</b>	<b>0.1</b>	<b>25</b>	<b>0.1</b>	<b>0.3</b>	<b>19</b>	<b>30</b>
<b>T/3<sup>2</sup></b>	<b>4</b>	<b>75</b>	<b>400</b>	<b>0.5</b>	<b>&lt;10</b>	<b>&lt;0.1</b>	<b>0.1</b>	<b>47</b>	<b>540</b>
<b>G/1<sup>2</sup></b>	<b>3</b>	<b>50</b>	<b>300</b>	<b>&lt;0.2</b>	<b>&lt;10</b>	<b>&lt;0.1</b>	<b>&lt;0.1</b>	<b>14</b>	<b>260</b>

# **Investigation of the permeability of coal fly ash at Jisr el Zarka**

**A monitoring of the drainage at the bridge embankment at Jisr was carried out during two winters (1998-1999; 1999-2000). Water was collected at two points:**

- 1) At the boundary (interface) between the upper soil cover (20 cm) and the ash; and**
- 2) at the bottom of the ash mass.**

**While water was collected and analyzed from the boundary; no water was collected during these years in the container at the bottom of the ash.**

## Infiltration rates in Road 6

<b>Year</b>	<b>Infiltration rate, mm/h</b>	<b>STDEV</b>
<b>2005</b>	<b>21.6</b>	<b>5.2</b>
<b>2006</b>	<b>11.8</b>	<b>3.6</b>
<b>2007</b>	<b>7.0</b>	<b>2.4</b>

**The results obtained from the ash at road 6 and in laboratory experiments confirm what was observed in Jisr: coal fly ash after absorbing and reacting with water and CO<sub>2</sub>, forms with time a practically impermeable mass.**



# **Precipitates, Runoff and Leachates at Jisr**

**Rain precipitation, runoff and drainage  
in winter 1998-99<sup>1</sup> and winter 1999-  
2000<sup>2</sup>. All results are in mm.**

	<b>Control</b>			<b>Ash</b>		
	<b>Rain</b>	<b>Soil surface</b>	<b>Bottom</b>	<b>Soil surface</b>	<b>Boundary soil-ash</b>	<b>Bottom of the ash</b>
<b>1</b>	<b>350</b>	<b>~120</b>	<b>36</b>	<b>~100</b>	<b>0.6</b>	<b>0</b>
<b>2</b>	<b>515</b>	<b>53</b>	<b>0</b>	<b>198</b>	<b>20.7</b>	<b>0</b>

**Average of microelements analyses results of the runoff on the soil cover and the leachates from the interface soil-ash due to the storms at 3.1.99, 20.1.99, and 15.4.99. The results are in ppb.**

	<b>Runoff</b>	<b>Leachates</b>
<b>B</b>	<b>152</b>	<b>774</b>
<b>Ba</b>	<b>52</b>	<b>134</b>
<b>Cr</b>	<b>&lt;1</b>	<b>22</b>
<b>V</b>	<b>3</b>	<b>17</b>
<b>Zn</b>	<b>81</b>	<b>85</b>

**Average of microelements analyses results  
of the runoff on the soil cover and the  
leachates from the interface soil-ash  
due to the storms at 16.12.1999 and 1.2.2000.  
The results are in ppb.**

	<b>Runoff</b>	<b>Leachates</b>
<b>B</b>	<b>66</b>	<b>292</b>
<b>Ba</b>	<b>55</b>	<b>102</b>
<b>Cr</b>	<b>2</b>	<b>8</b>
<b>V</b>	<b>6</b>	<b>10</b>
<b>Zn</b>	<b>154</b>	<b>363</b>

# **Sampling of the ash at the bridge embankment in Jisr**

**The drill at the bridge embankment was problematic. The first trial was on July 27<sup>th</sup>. 2006. After half an hour of difficult drilling, the hard tip of the drill broke. After changing to a larger one, it broke down again almost immediately. The second trial was on the 5<sup>th</sup> September 2006, after repairing the two drills and sharpening them. It was difficult to drill with the small drill and the larger was used. We were able to drill to a depth of 160 cm. Then a harder layer occurred which caused the breaking of the drill. The sampling was completed only on the 13<sup>th</sup> March 2007, using a “spiral” drill in the hard layers.**





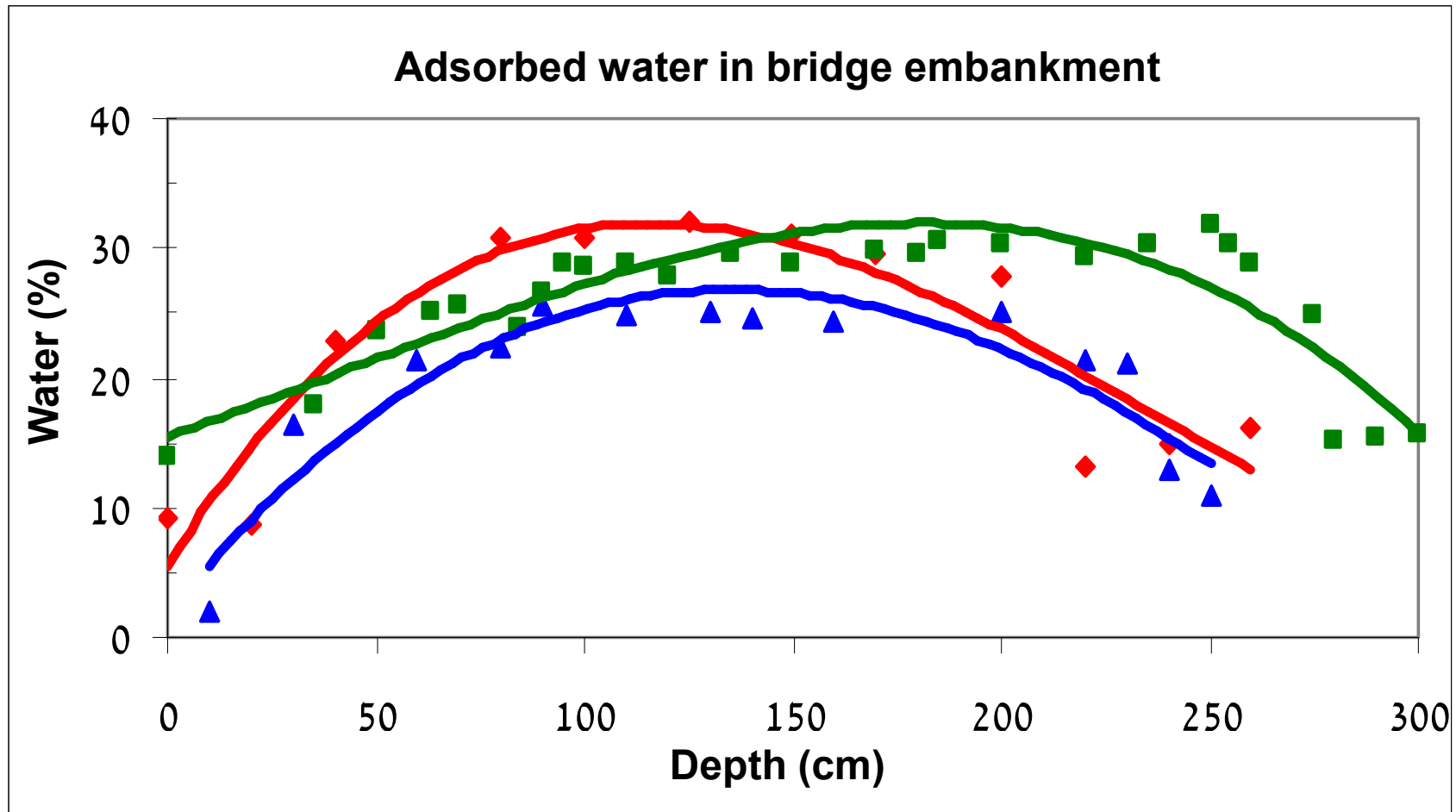
**Similar problems were encountered earlier when drilling the embankments in Hadera (Orot Rabin Power Plant). Such as encountering very hard layers and breaking drills. (Report GSI/20/96, Jerusalem, June 1996)**

# **Monitoring of the Chemistry and Mineralogy of the coal ash in Jisr**

**The monitoring was carried out three times in the years 2000, 2003, and 2006-7.**

# Comparison of the analyses of some trace elements in the fly ash in Jisr. Results in ppm.

	Original, 1997 n=2	sampled in 2000 n=11	sampled in 2005/6 n=21
As	36	10	17
B	220	194	233
Ba	2300	2508	2276
Cd	0.6	0.6	0.6
Cr	150	160	156
Hg	0.5	0.6	0.23
Pb	70	40	63
Se	22	5	8

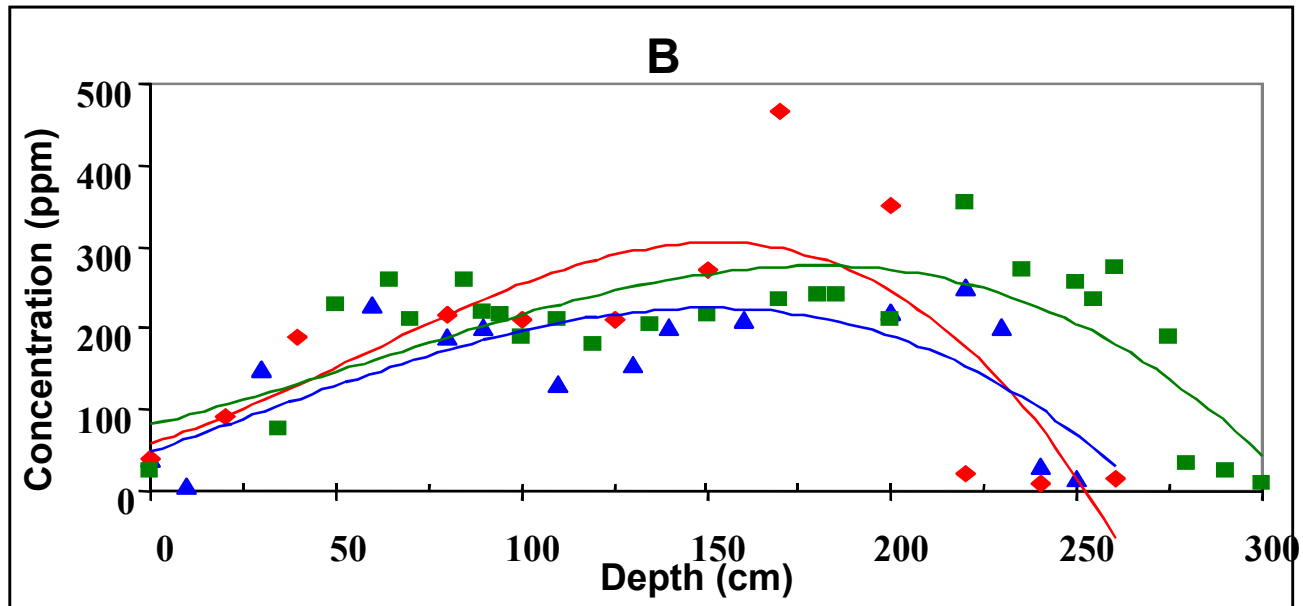
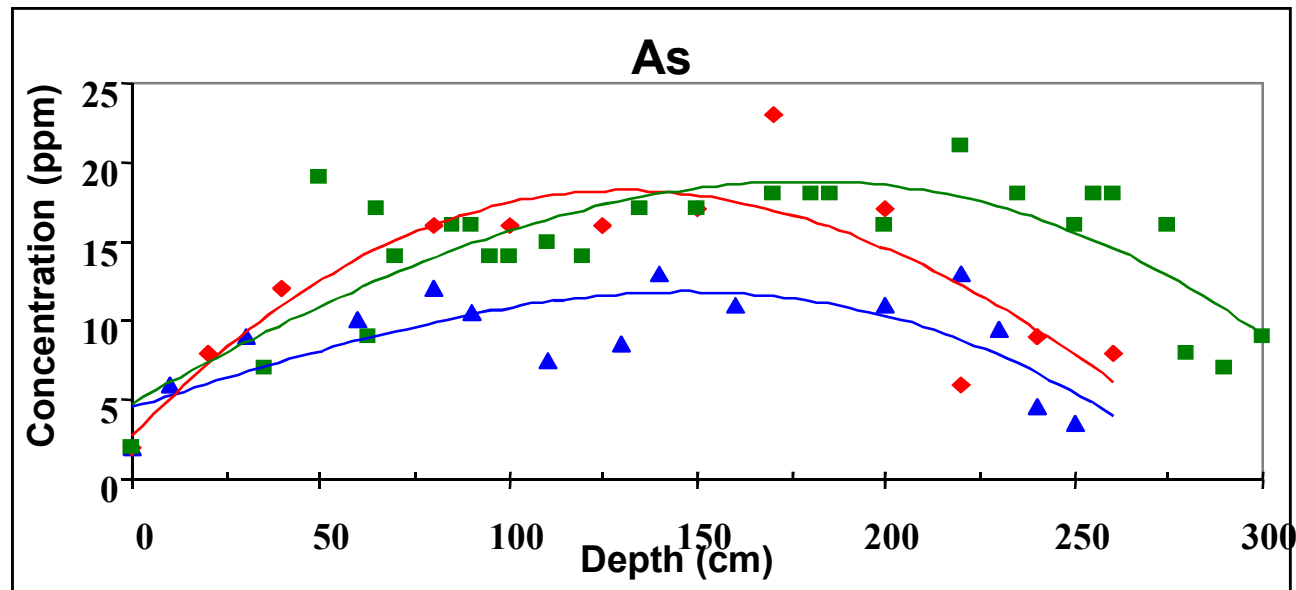


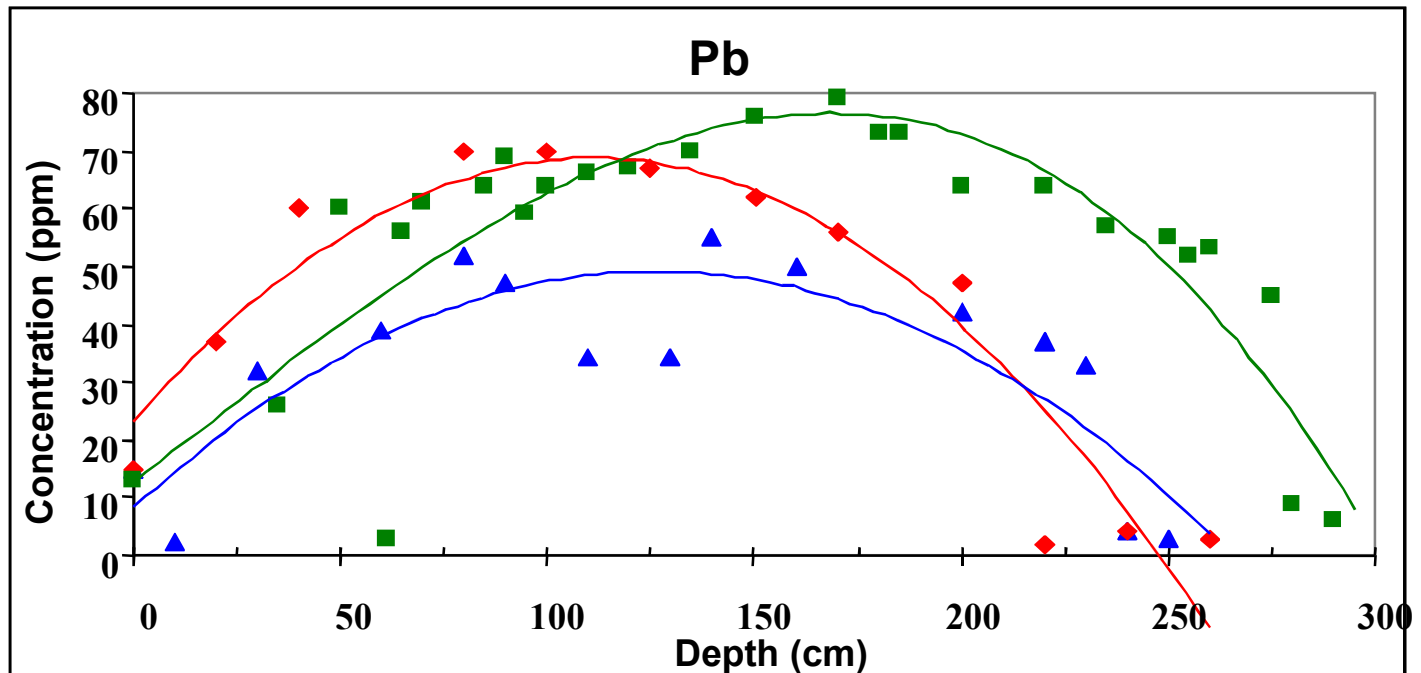
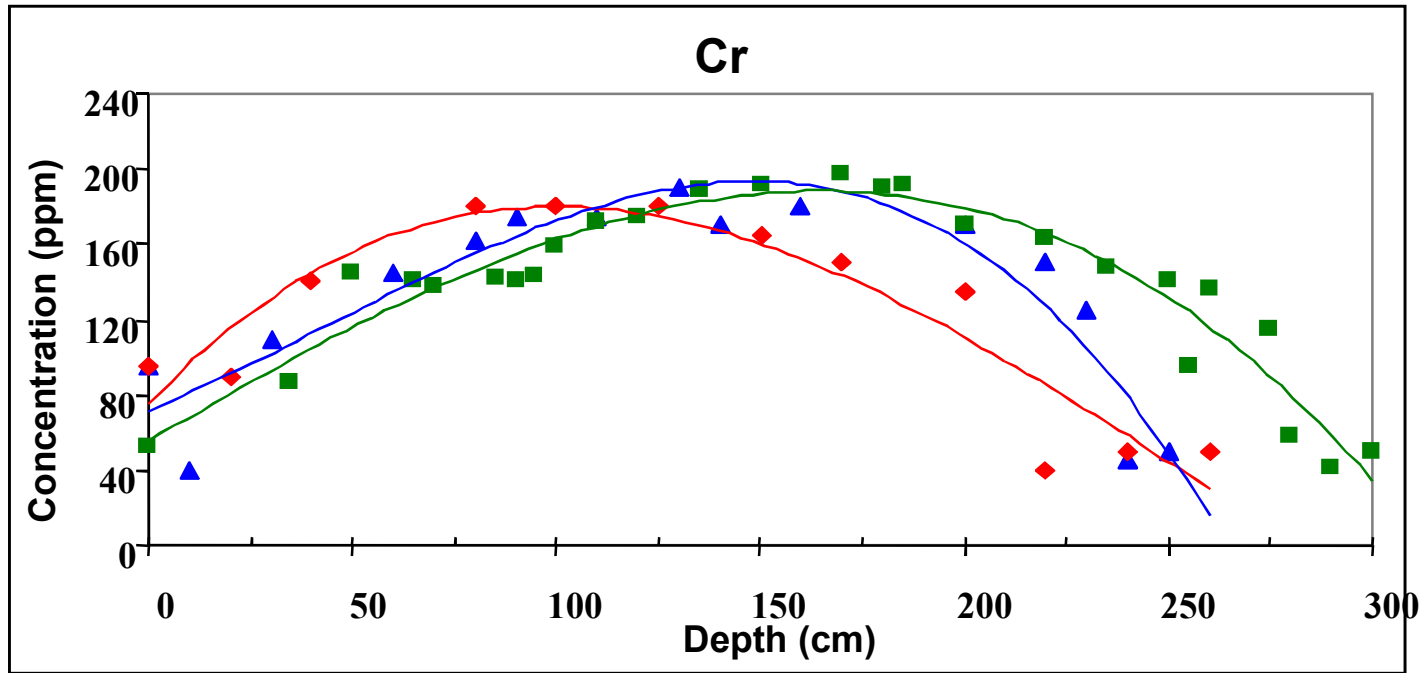
**Blue triangle – sampling in 2000**

**Red diamond – sampling in 2003**

**Green square – sampling in 2006**

# Concentration of trace elements as function of depth





# Comparison of TCLP results

the results are in ppb.

	Original ash (n=4)	Ash sampled in 2006/7 (n=21)
As	132	32
B	8038	7492
Ba	440	917
Cd	1.7	1.2
Cr	609	713
Hg	0.1	0.017
Pb	5	1.3
Se	80	8

# Conclusions

**There are differences of opinion about the relative importance of the reactions which occur between fly ash and water and fly ash and CO<sub>2</sub> in structural fills in road construction.**

**Nevertheless, it is clear that in this use of fly ash, the mass of fly ash becomes impermeable and thus presents no danger to the environment.**