

Fly Ash Uses in Road  
Construction, Infrastructure and  
Agriculture - Scientific  
Background for Regulatory  
Protocols

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**The European directive sets conditions for landfill disposal assuming the landfill is exposed to rain water, either**

- Runoff over its surface**
- Percolation through it**
- Capillary rise from its base**

**Dynamics in FA changes (pH, HC, Dissolution rate) and soil properties were not considered**

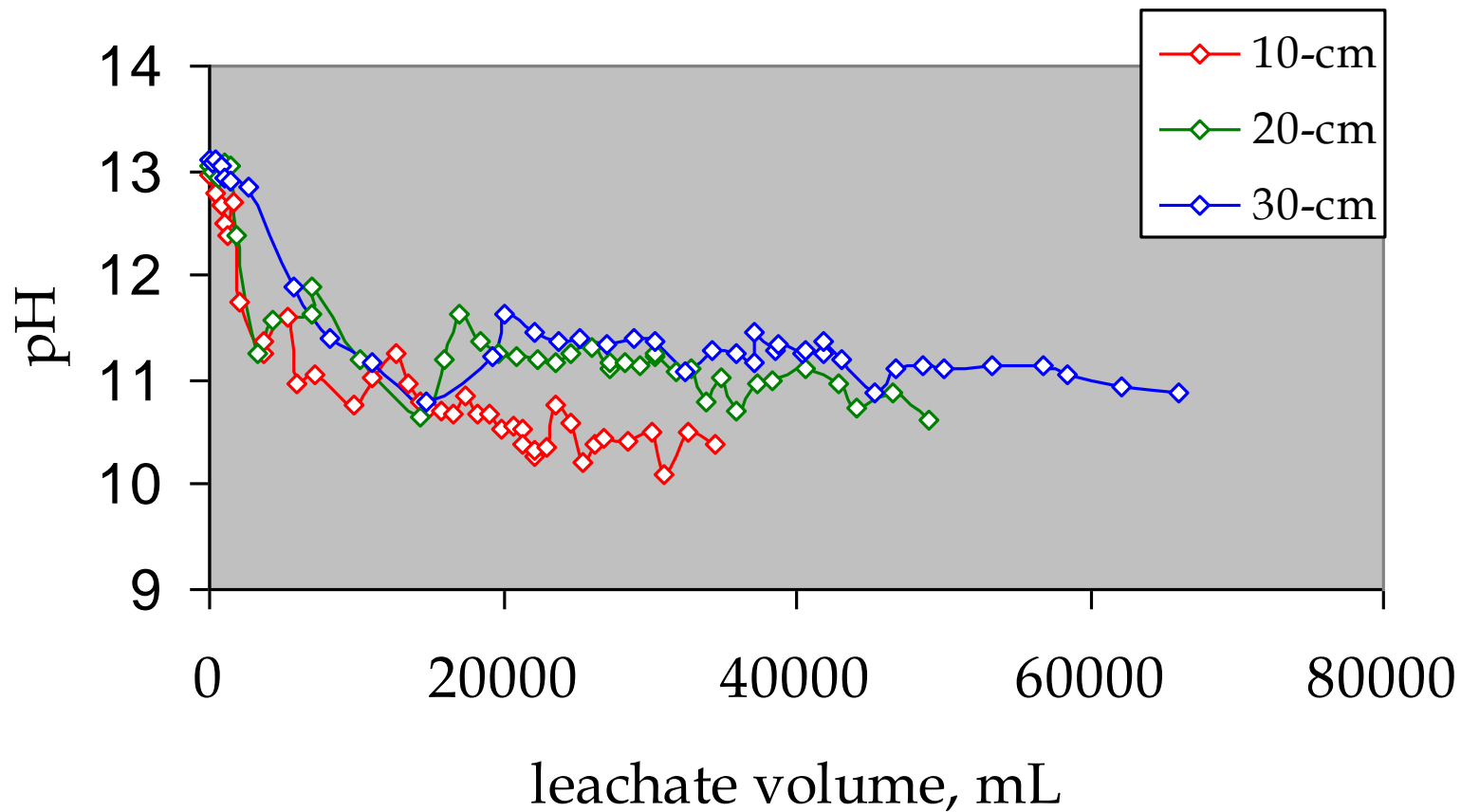
# Aging

- pH dependent dissolution
- Hydraulic Conductivity

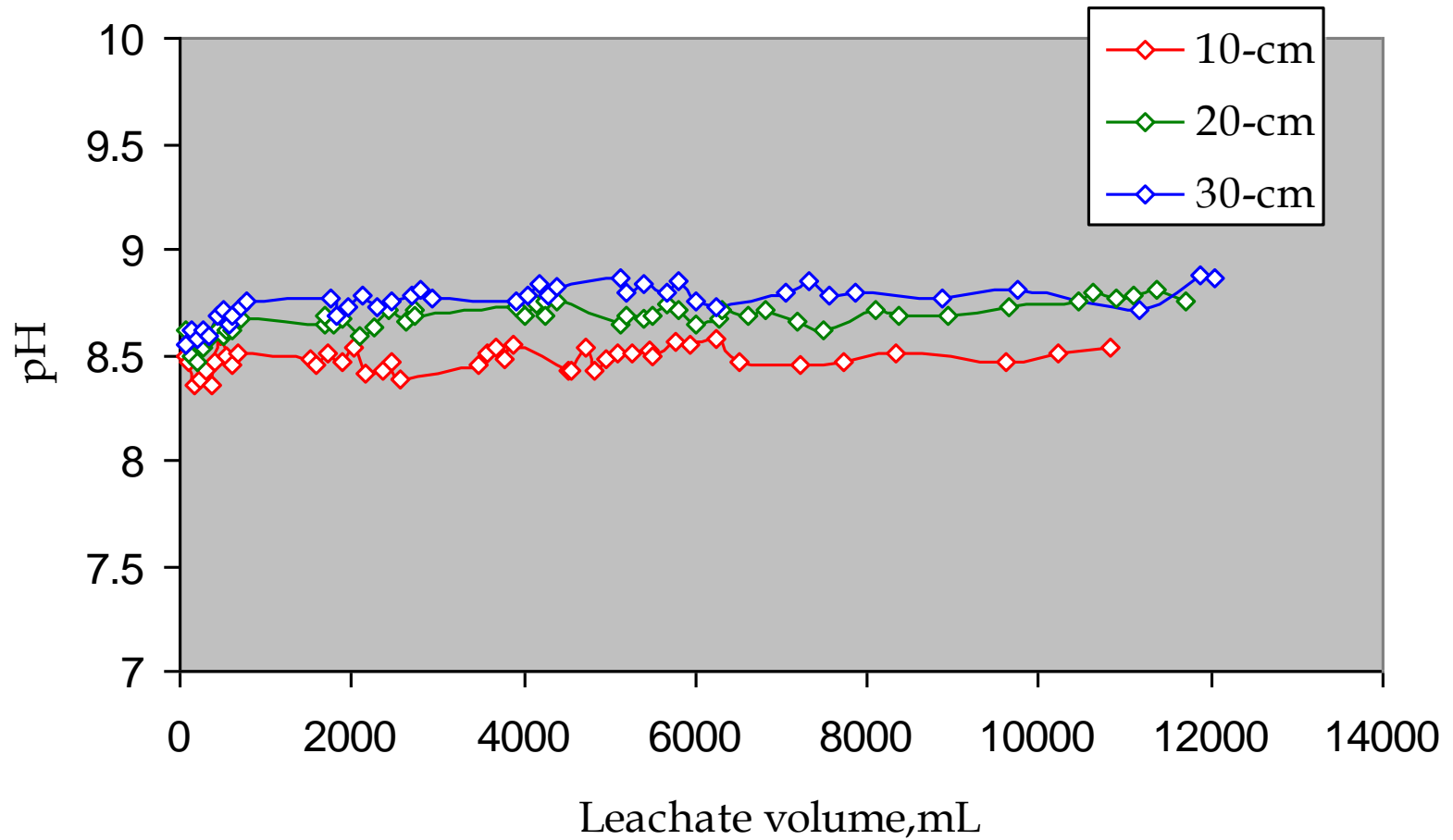
# Fly ash from South Africa

- Fresh and dry fly ash was kept isolated from atmosphere
- Aging time of wet fly ash (water content of 30-40%) exposed to atmosphere for 0,3,6,12 months

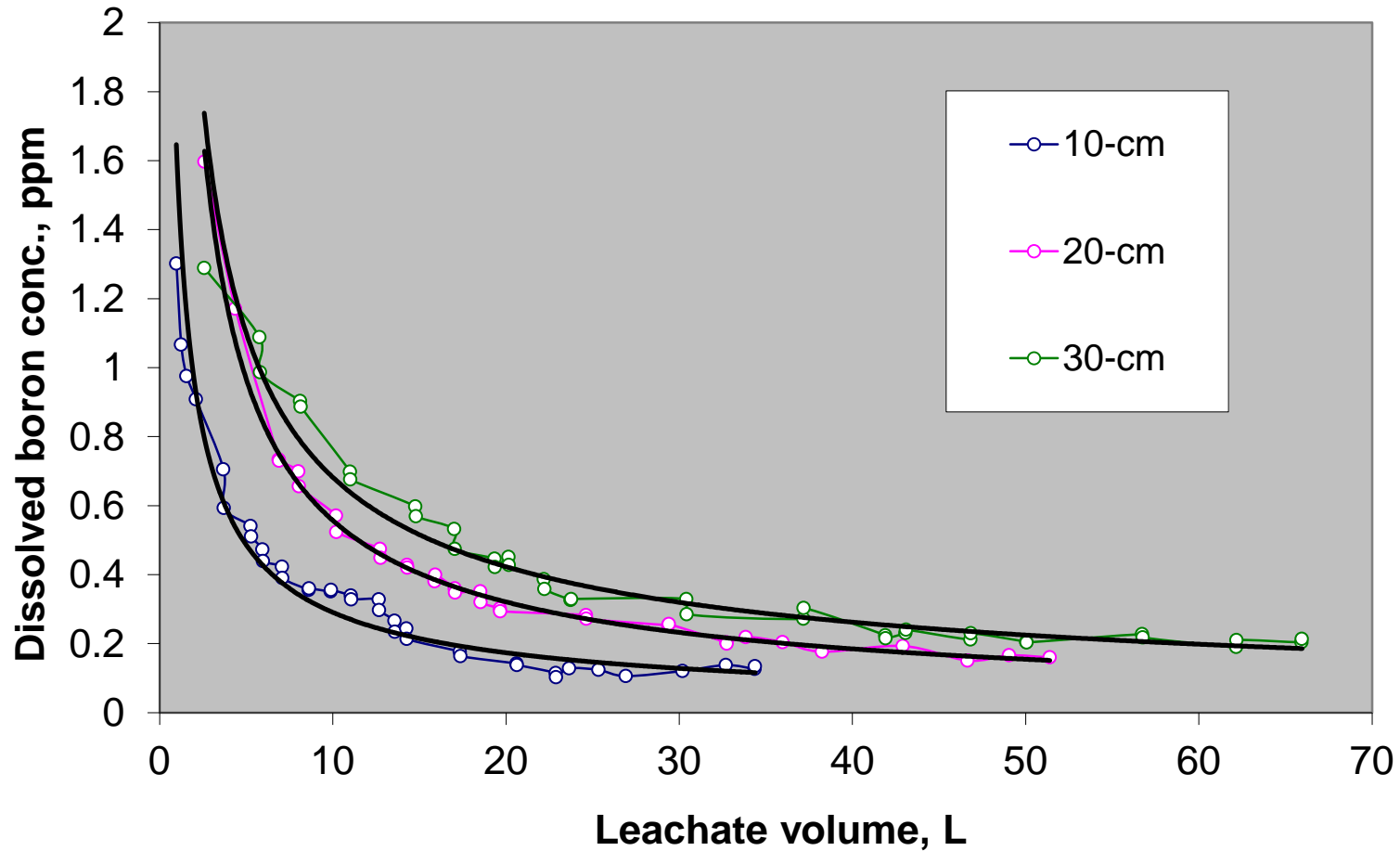
### pH, t=0 months



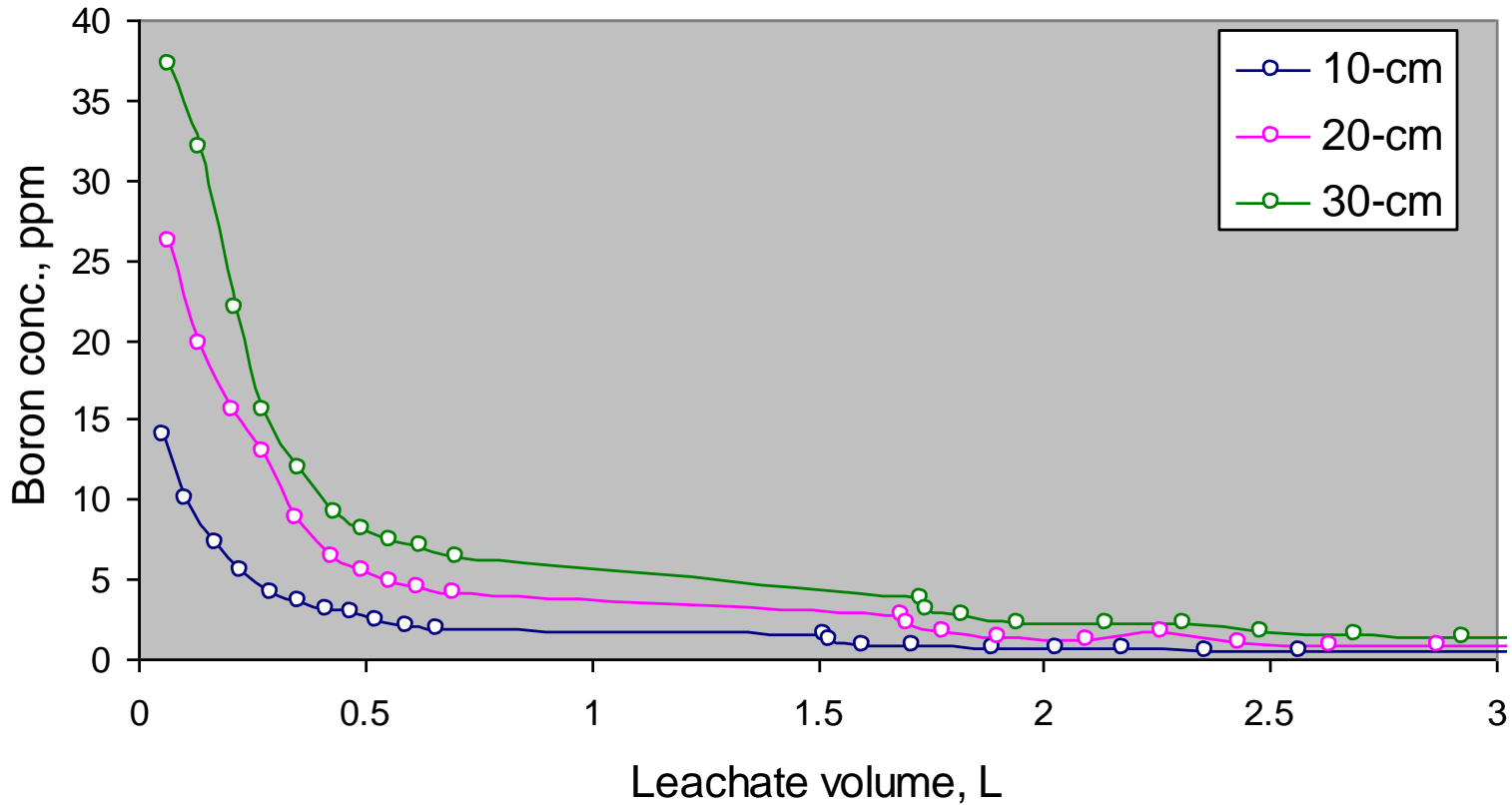
# pH, t =12 months



## Boron concentration in leachate, $t_0$

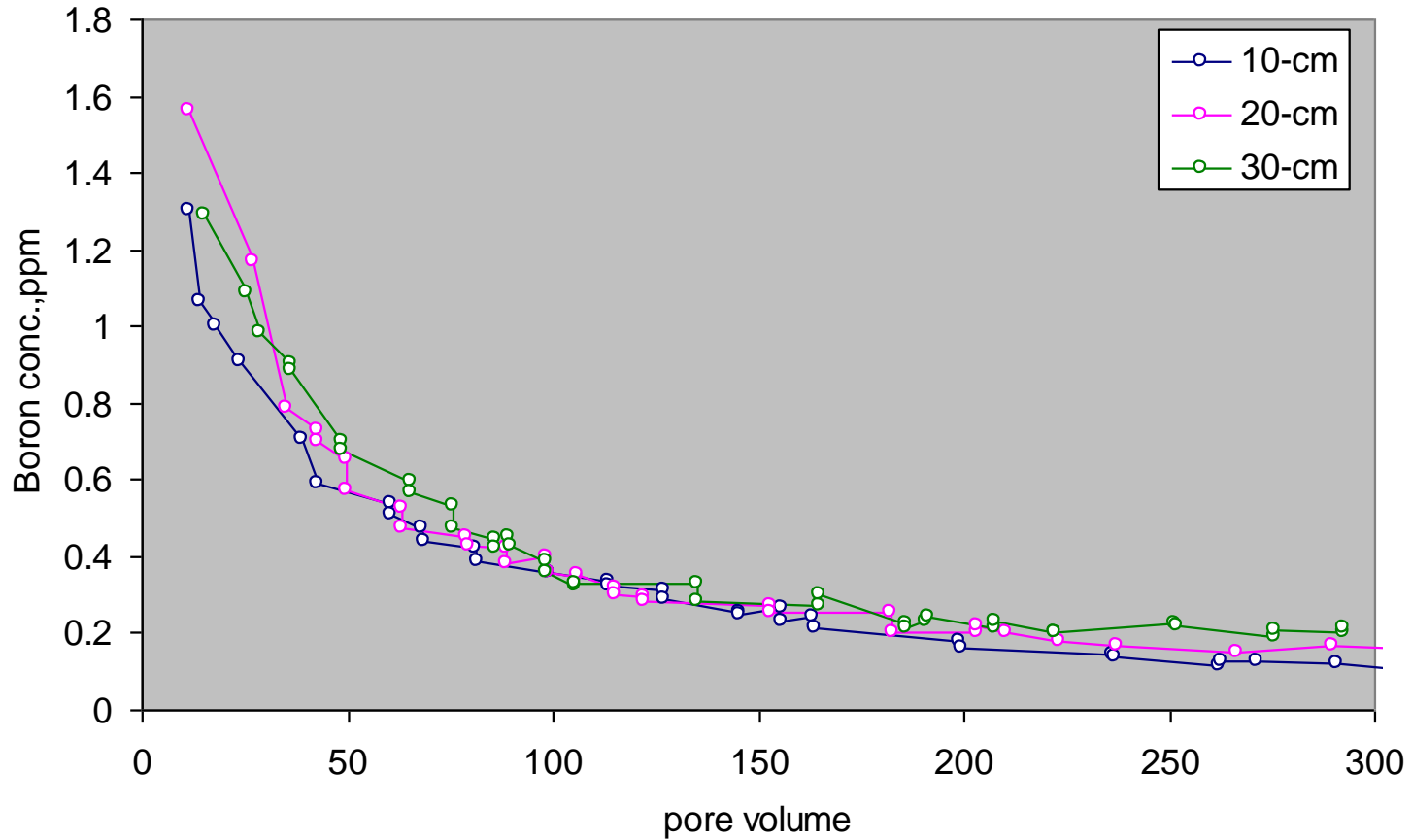


## Boron concentration in leachate, t = 12 months



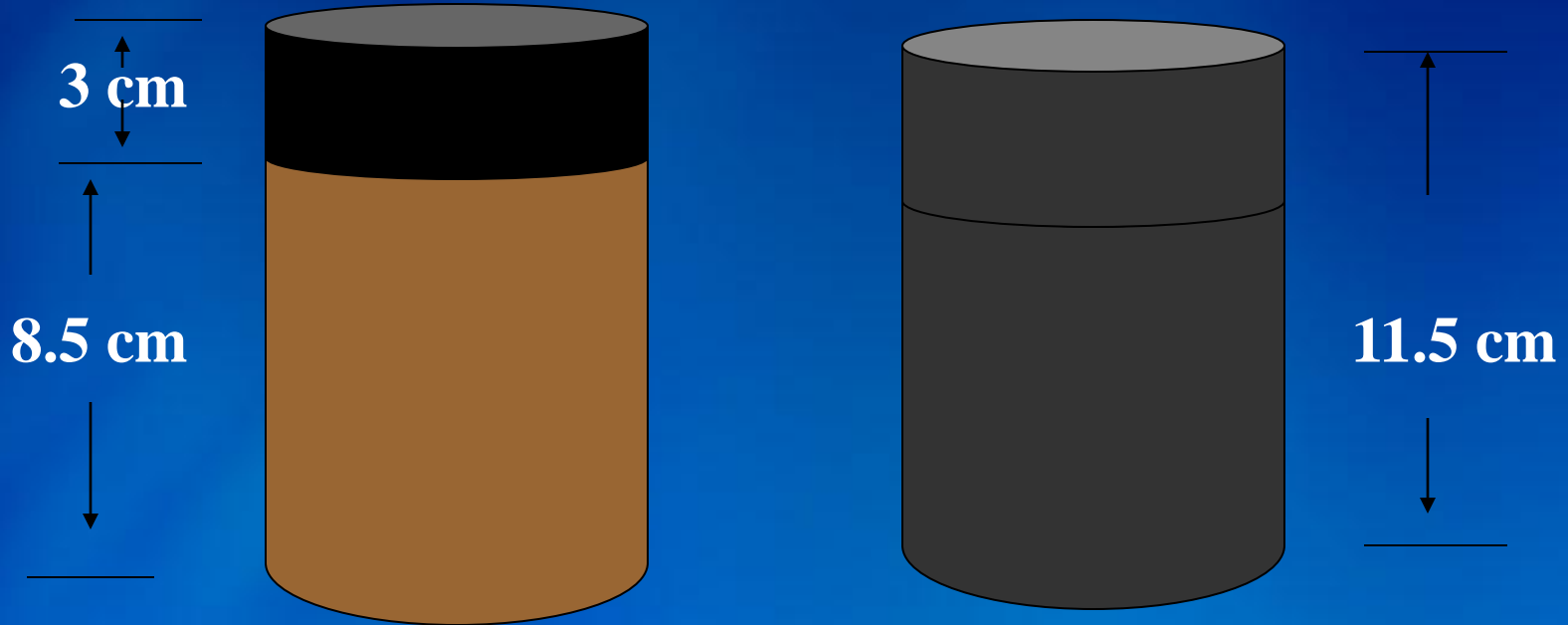


### Boron concentration in leachate, t = 0 month



**Fly ash above soil**

**Fly ash-soil mixture**



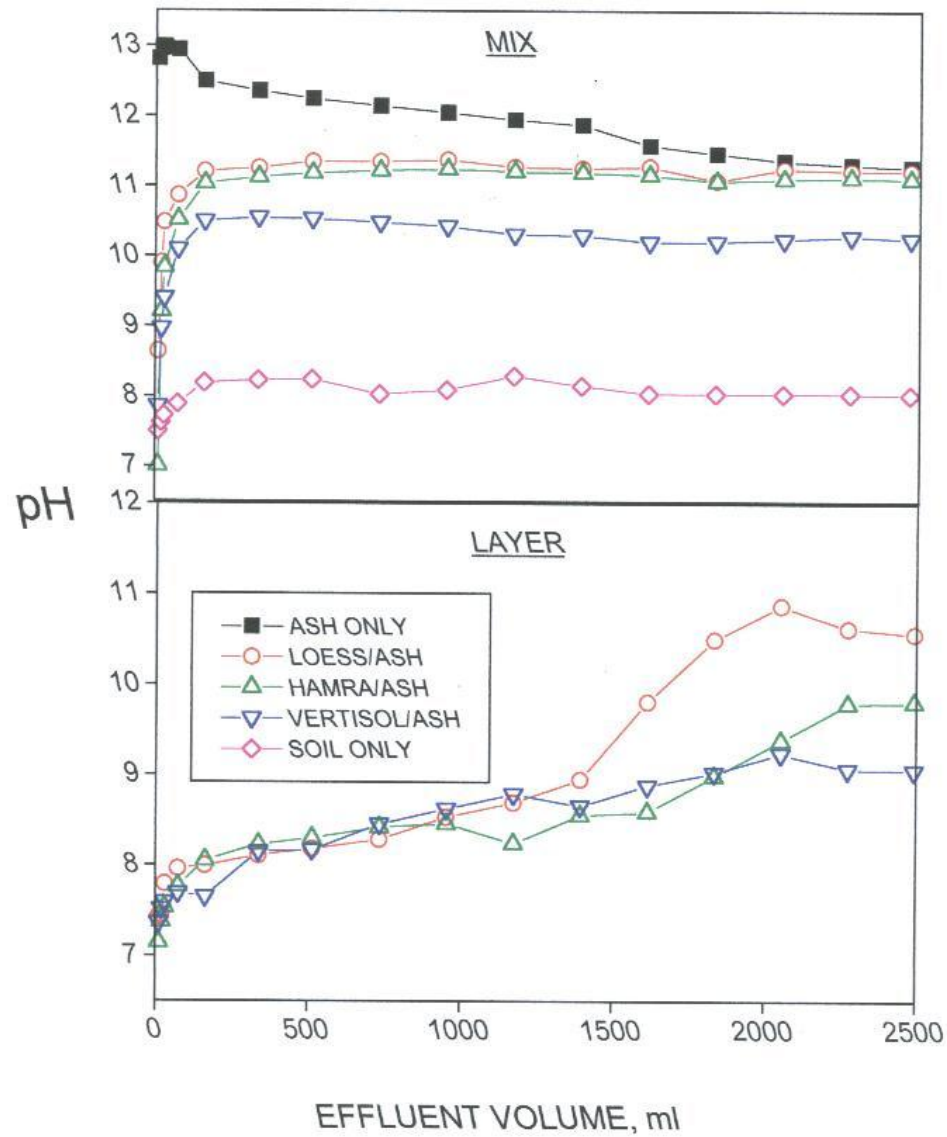
**PV 128 mL**

**PV 120 mL**

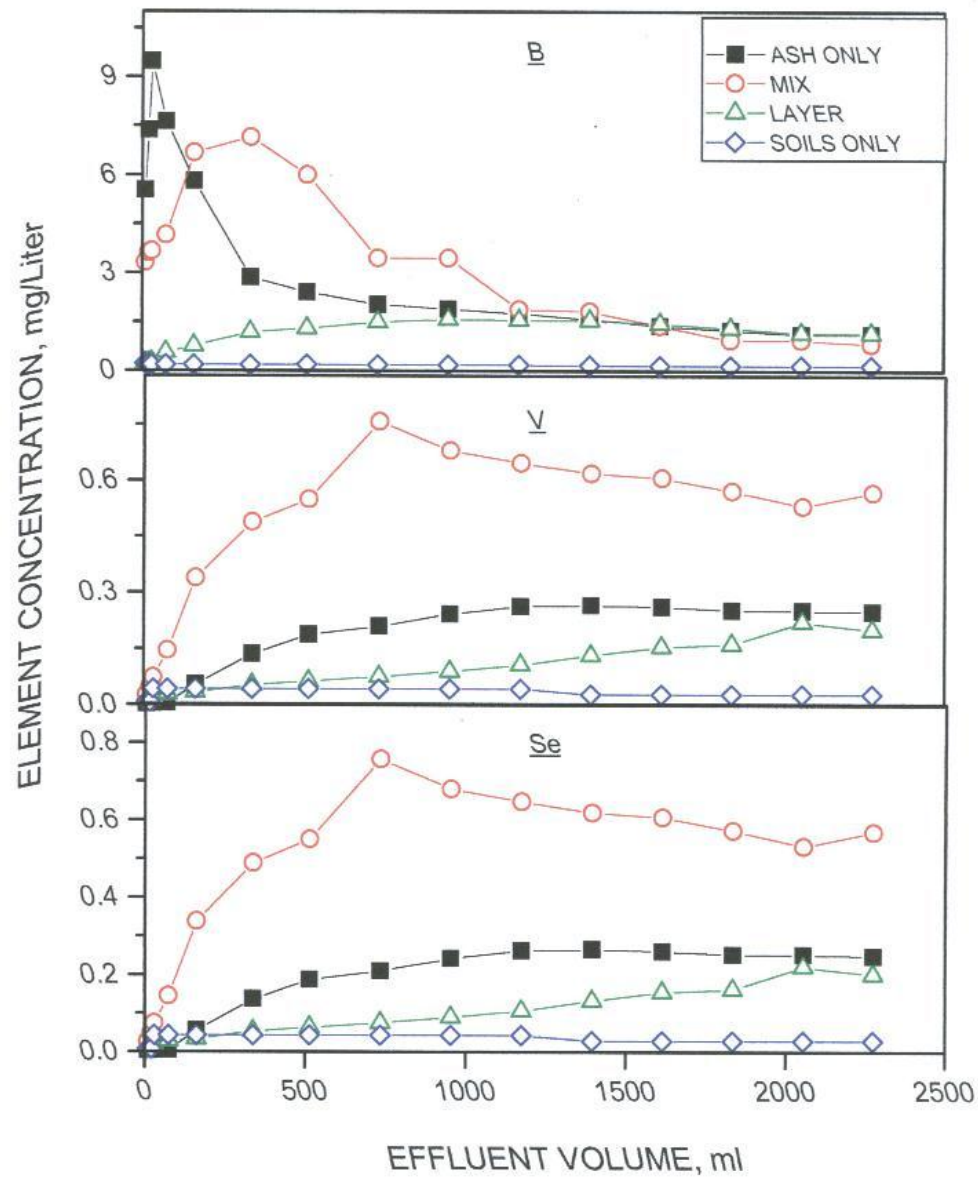
**Soil: 250 g**

**Fly ash: 50 g**

**Water flux 108 mm/h**



איור 16: השתנות ה-pH בתשמיץ עמודות אפר, קרקע ואפר עם קרקע בצורת אריזה של תערובת הומוגנית ושיכוב כתלות בנפח הנקבובים שעבר בעמודה.



איור 17: השתנות ריכוז המיקרואלמנטים B, V ו-Se בתשמיף מעמודת אפר, קרקע ורטיסול ואפר עם קרקע ורטיסול בצורת אריזה של תערובת הומוגנית ושיכוב כתלות בנפח התמיסה השוטפת.

$$Q_B = T \left\{ 1 + \frac{PR}{F(Q_T - Q_B)} [1 + K_{OH}(OH)] \right\}^{-1}$$

$$P = 1 + K_h * 10^{14} * (OH)$$

$$F = K_{HB} + K_B (P - 1)$$





# Fly ash in roadbed

## Infiltration rate as a function of time


<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>



**Hence, compacted coal ash layer  
behaves as an inert monolith  
when used in road infrastructure.**

# CONCLUSIONS

- **The leachate pH decreases with the exposure time of the moist fly ash to the atmosphere**
- **Except V, the oxyanions concentration in the leachate increases as the pH decreases at any given leachate volume**
- **The B, Mo, Cr and V concentrations in the leachate increase with the length of the fly ash column at any given leachate volume**
- **The oxyanions concentrations in the leachate are independent of the fly ash column length when the leachate volume is presented as pore volumes**



**The oxyanions concentration in the leachate leaving the fly ash-soil mixture is greater than that found in the leachate leaving the soil underneath the fly ash layer for the same amount of fly ash and soil.**



**The infiltration rate of a compacted fly ash later in road construction decreases with time (due to aging)**

● The regulatory protocol for fly ash uses in road construction, infrastructure and agriculture should take into consideration the following:

- Fly Ash Aging and pH dependant dissolution potential and rate of elements
- Soil Characterization and depth
- Water quality, velocity rate and flow direction in the aquifer related to the application location of FA
- Models to simulate dissolution of elements from fly ash (pH and HC) and adsorption-desorption by soils as a function of pH and soil properties .