

# Leaching of blast-furnace sludge

# Chemical composition

---

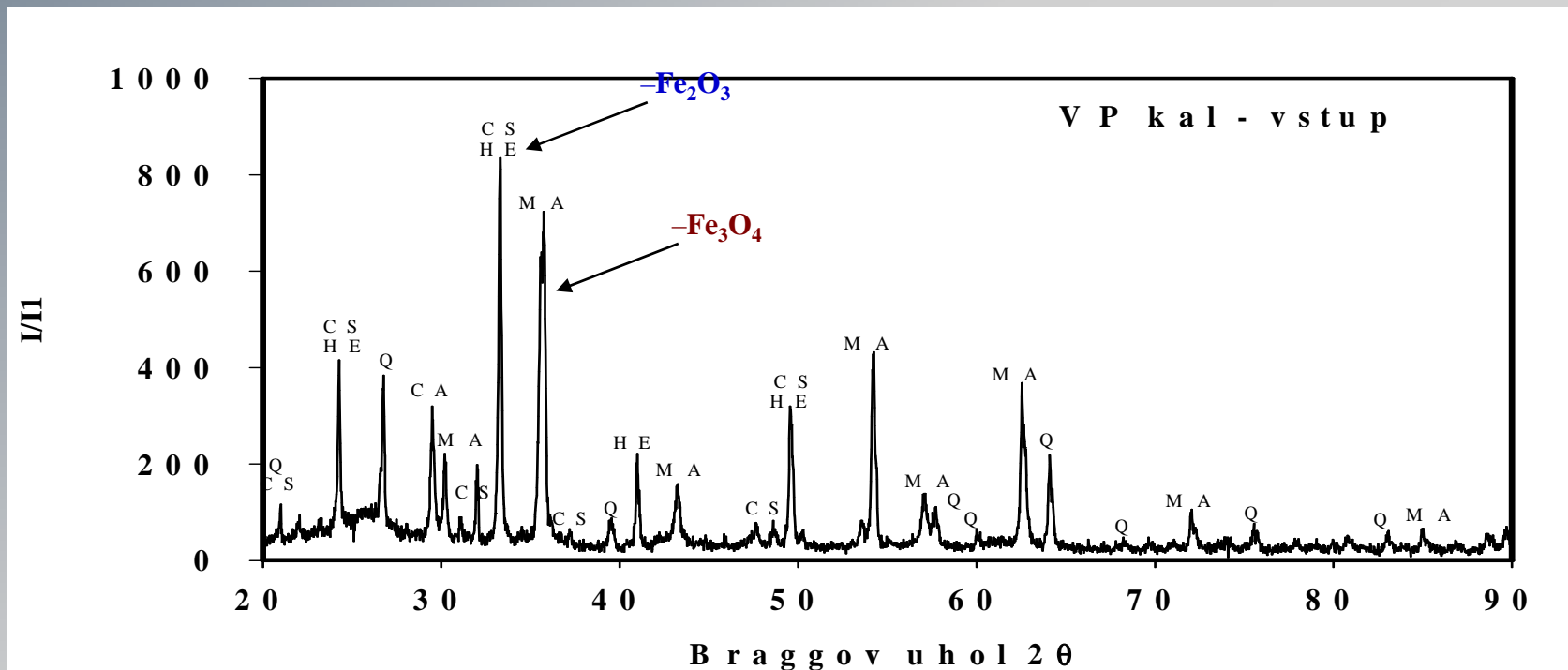
*BF dust of USS Kosice:*

compound	%	compound	%
Fe	32,94	Sn	0,17
Si	5,58	Cu	0,24
Zn	1,54	Cr	trace
Pb	0,15	LOI	20,24
Sb	0,15		

# The problem

## *BF dust of USS Kosice:*

- mineralogical composition:*



# The problem

---

## *BF sludge of USS Kosice:*

- *mineralogical composition:*

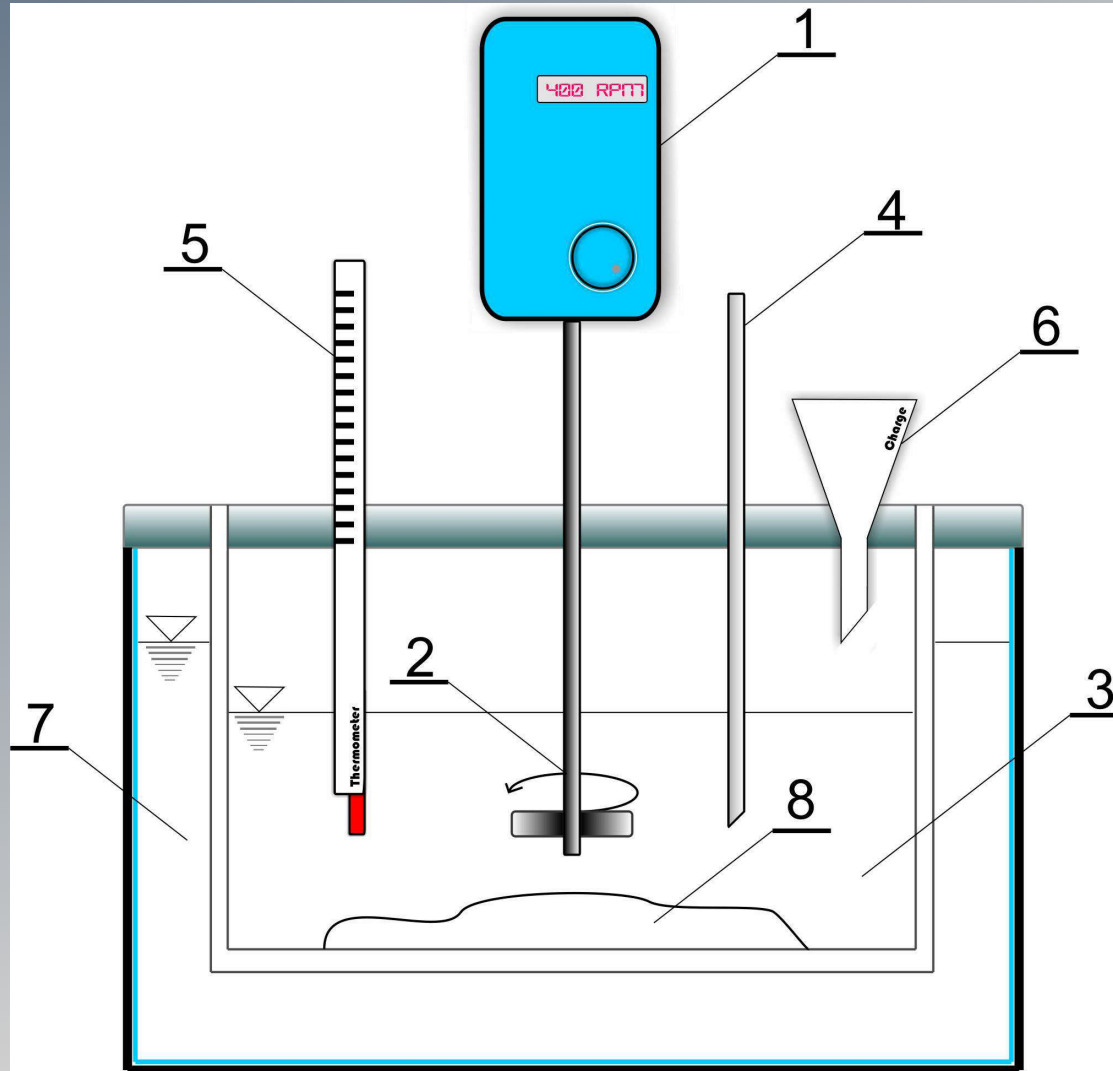
$\text{Fe}_2\text{O}_3$	hematite	significant
$\text{Fe}_3\text{O}_4$	magnetite	significant
$\text{CaFeSiO}_4$	kirschsteinite	significant
$\text{SiO}_2$	quartz	less
$\text{CaCO}_3$	calcite	less

## *low content of Zn*

$\text{ZnO}$  zincite ?

$\text{ZnFeO}_2$  franklinite ?

# The experiment



- 1 - stirrer engine
- 2 - propeller
- 3 - pulp
- 4 - sampler
- 5 - thermometer
- 6 - feeder
- 7 - water seal
- 8 - water thermostat
- 9 - sample

# The experiment



at


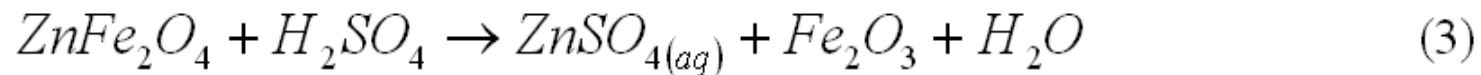
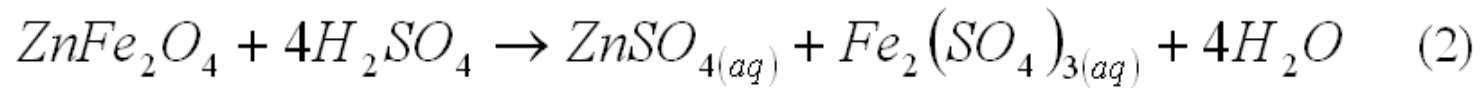
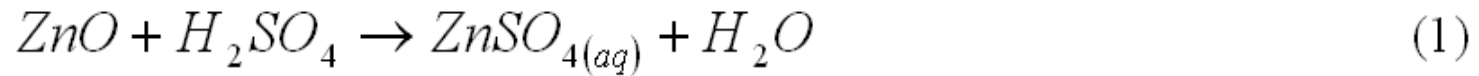
# The experiment

---

Leaching solution:	300 ml H <sub>2</sub> SO <sub>4</sub>
Concentration:	0,5 M, 1M, 2M
Temperature:	20, 50, 80 °C
Stirring:	300 rev
Sludge sample amount:	50 g dried/crushed sludge
Sampling:	15, 30, 45, 60, 90, 120 minutes
Analytical sample amount:	5 ml
Analytical method:	AAS (Varian Spectrometer AA 20+)
Traced elements:	Zn, Fe

# Leaching reactions

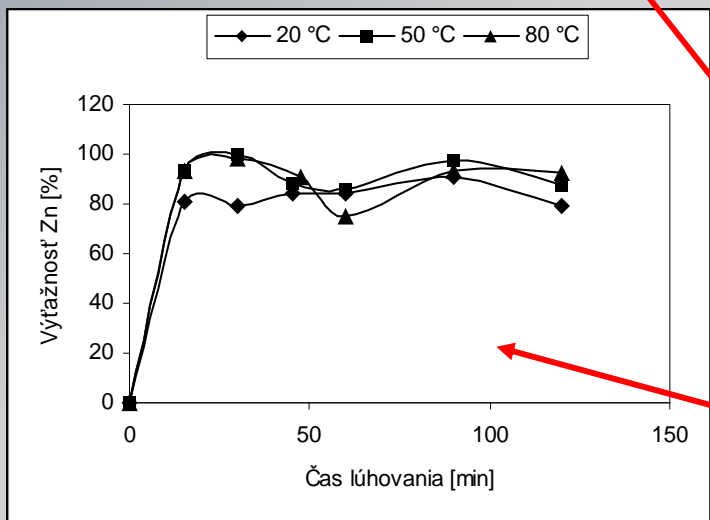
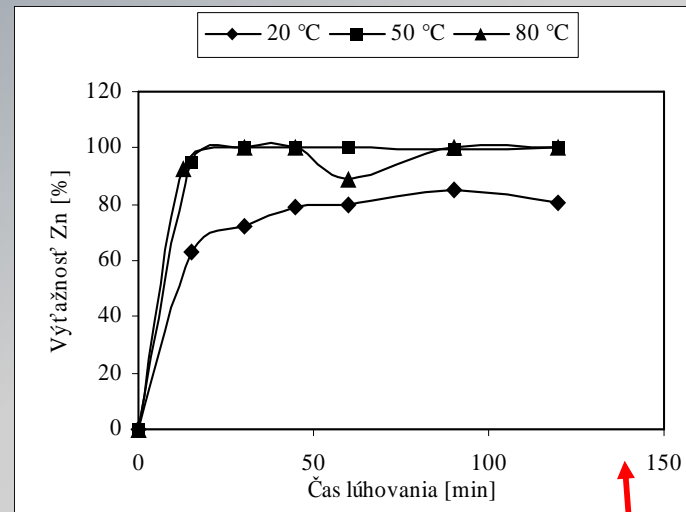
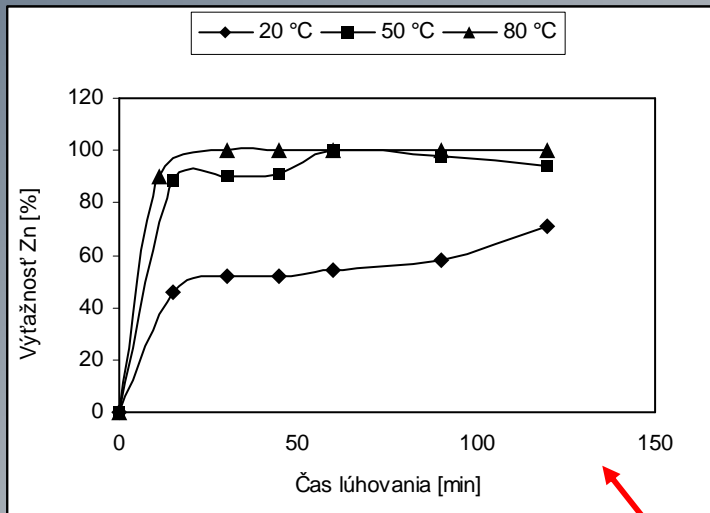
---



thermodynamically more advantageous as the equations (3) and (4) in whole temperature range



# Leaching



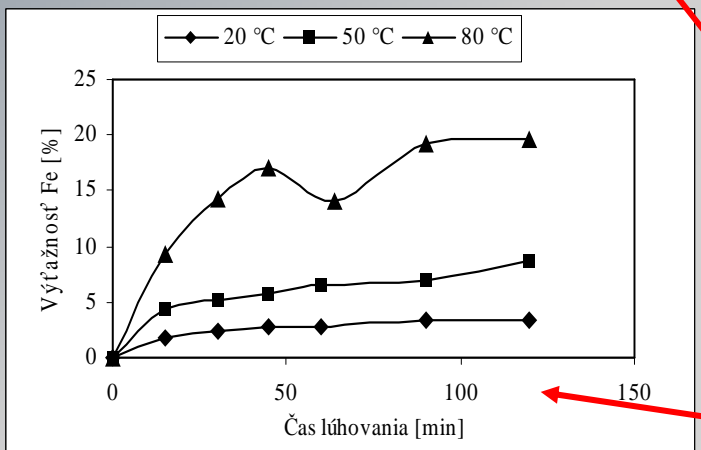
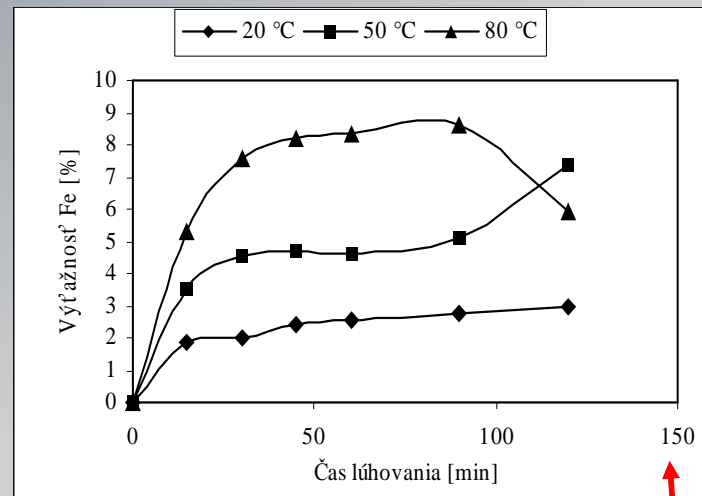
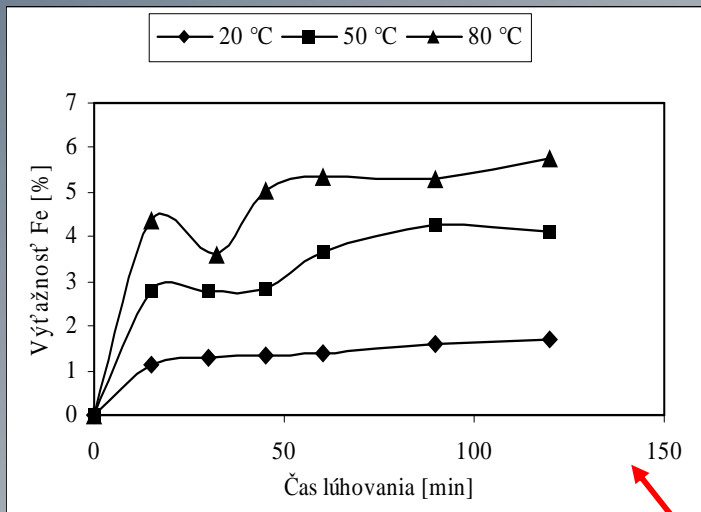
*Temperature dependence of Zn extraction at:*

$$C_{\text{H}_2\text{SO}_4} = 0,5 \text{ M}$$

$$C_{\text{H}_2\text{SO}_4} = 1,0 \text{ M}$$

$$C_{\text{H}_2\text{SO}_4} = 2,0 \text{ M}$$

# Leaching



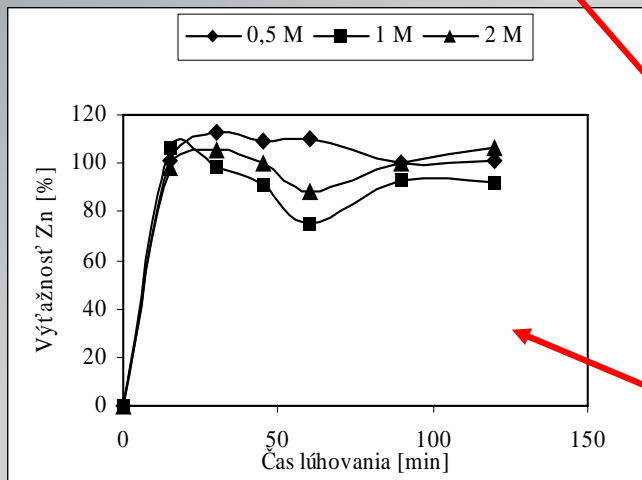
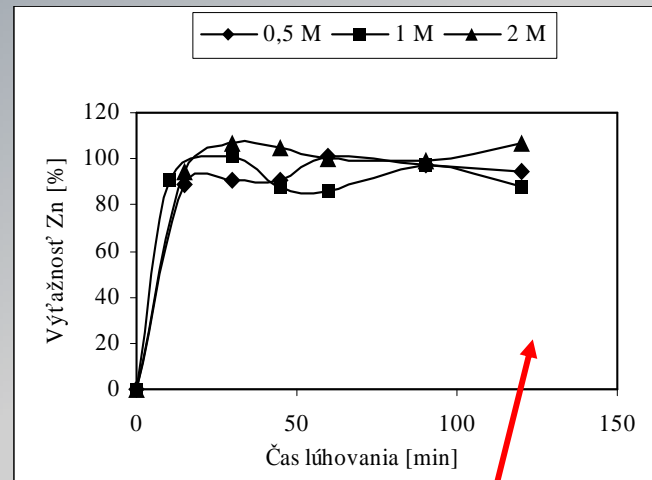
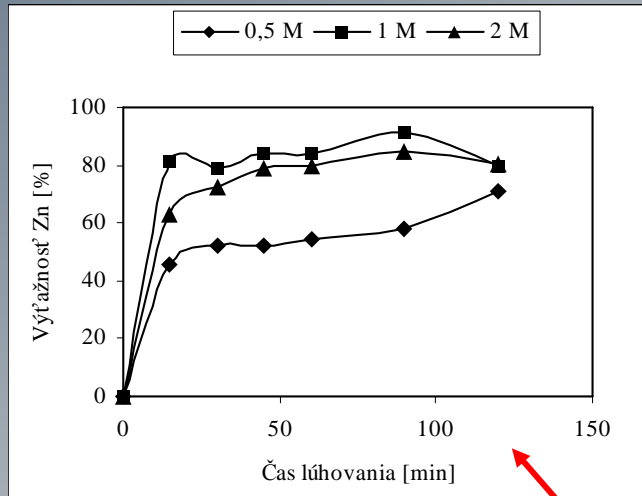
*Temperature dependence of Fe extraction at:*

$$C_{\text{H}_2\text{SO}_4} = 0,5 \text{ M}$$

$$C_{\text{H}_2\text{SO}_4} = 1,0 \text{ M}$$

$$C_{\text{H}_2\text{SO}_4} = 2,0 \text{ M}$$

# Leaching



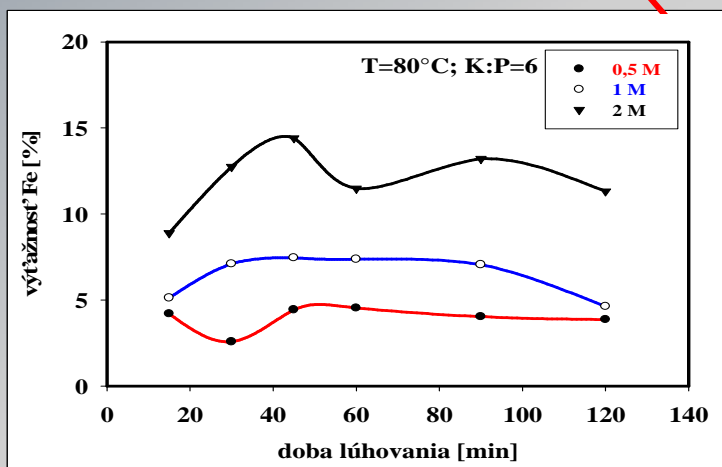
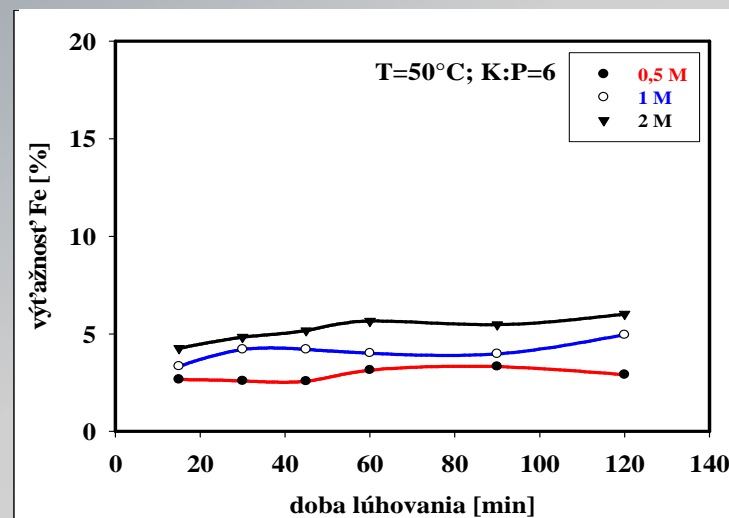
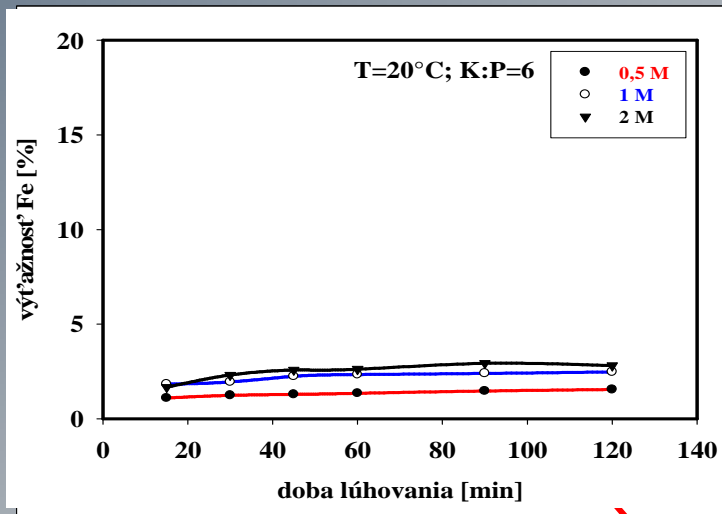
*Concentration dependence of  
Zn extraction at:*

**t = 20 °C**

**t = 50 °C**

**t = 80 °C**

# Leaching



*Concentration dependence of Fe extraction at:*

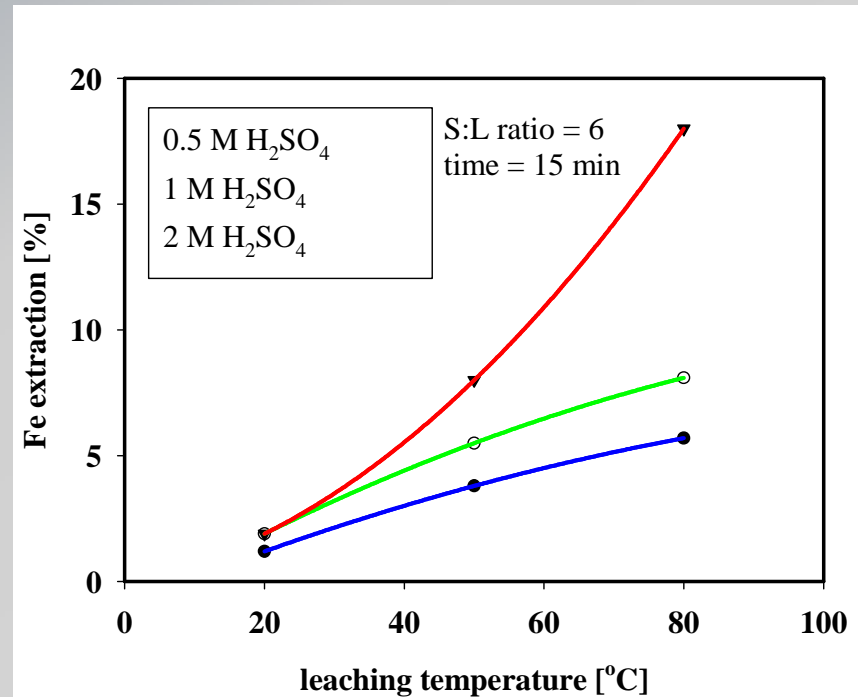
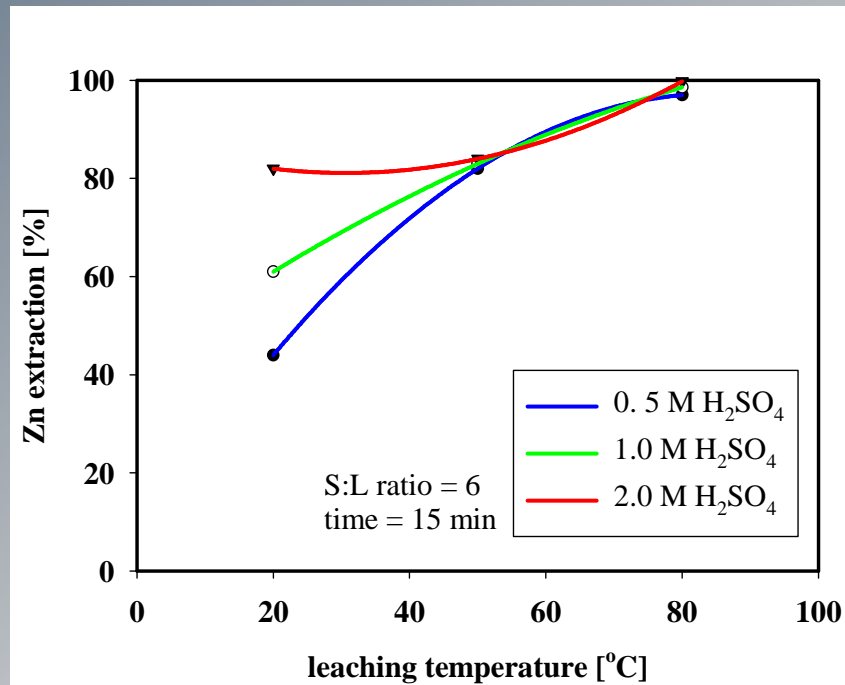
$t = 20^{\circ}\text{C}$

$t = 50^{\circ}\text{C}$

$t = 80^{\circ}\text{C}$

# Leaching

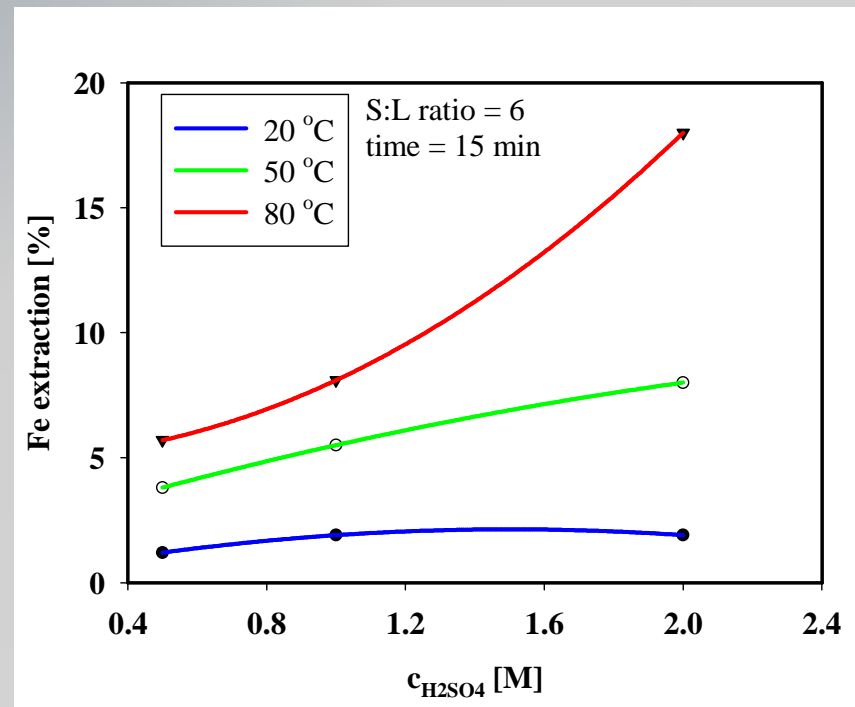
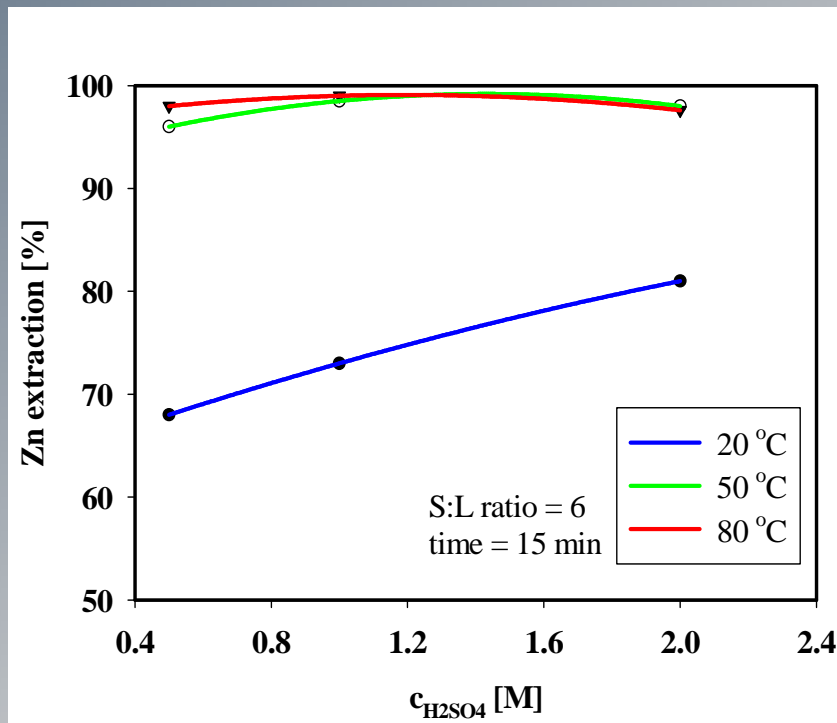
L:S ratio = 6; leaching time = 15 min



*Kinetic curves of Zn and Fe extracted depending on temperature and sulfuric acid concentration*

# Leaching

L:S ratio = 6; leaching time = 15 min



*Kinetic curves of Zn and Fe extracted depending on sulfuric acid concentration and temperature*

# Leaching

---

t [°C]	Zn extract. [%]			Fe extract. [%]		
	0.5 M	1.0 M	2.0 M	0.5 M	1.0 M	2.0 M
20 °C	68.1	73.12	81.09	1.21	1.91	1.93
50 °C	96.4	98.13	98.65	3.8	5.5	8.02
80 °C	98.2	99.04	97.8	5.7	8.1	18.23

# Conclusions

---

- At high temperatures already in first 15 minutes whole amount of Zn is extracted into solution
- As follows from E-pH diagrams, at  $\text{pH} = 0,14$  iron precipitated as  $\text{FeO.OH}$ , or, at high temperature, as  $\text{Fe}_2\text{O}_3$
- The optimum conditions for leaching of blast-furnace sludge (USS Kosice, Slovakia) is leaching in  $0.5 \text{ M H}_2\text{SO}_4$  at  $50 \text{ }^\circ\text{C}$ , when more than 95 % Zn and less than 4 % Fe is leached into solution



# Conclusions

---

- Arising both of temperature and acid concentration causes Zn extraction into solution up to around 100 %
- Fifteen minutes of leaching is fully sufficient for zinc transfer into solution
- Arising both of temperature and acid concentration causes Fe extraction into solution, but maximum is 18 %
- At 20°C Zn extraction arising with leaching time

**Definitively  
nothing more**

**GAME OVER**