



Heat Transfer and Fluid Flow Laboratory
Brno University of Technology, Faculty of Mechanical Engineering



Mechanical descaling by high pressure water jet

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Workshop on Pickling Solutions Technology
13th of November 2019, Düsseldorf

Introduction

- Brno University of Technology, Czech Republic
- Hydraulic descaling of coils of wires
- Laboratory experiments
 - Impact pressure distribution measurement
 - Hydraulic descaling
 - EDX Analysis with a Scanning Electron Microscope
- Conclusion



Brno, Czech Republic



Brno University of Technology



- Faculty of Architecture
- Faculty of Business and Management
- Faculty of Chemistry
- Faculty of Civil Engineering
- Faculty of Electrical Engineering
- Faculty of Fine Arts
- Faculty of Information Technology
- Faculty of Mechanical Engineering

Total students: 19 240

Founded 1899



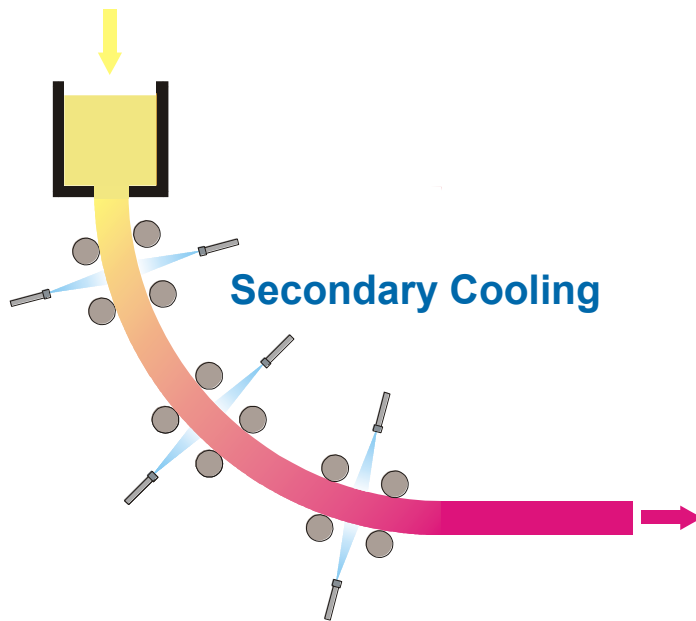
Faculty of Mechanical Engineering



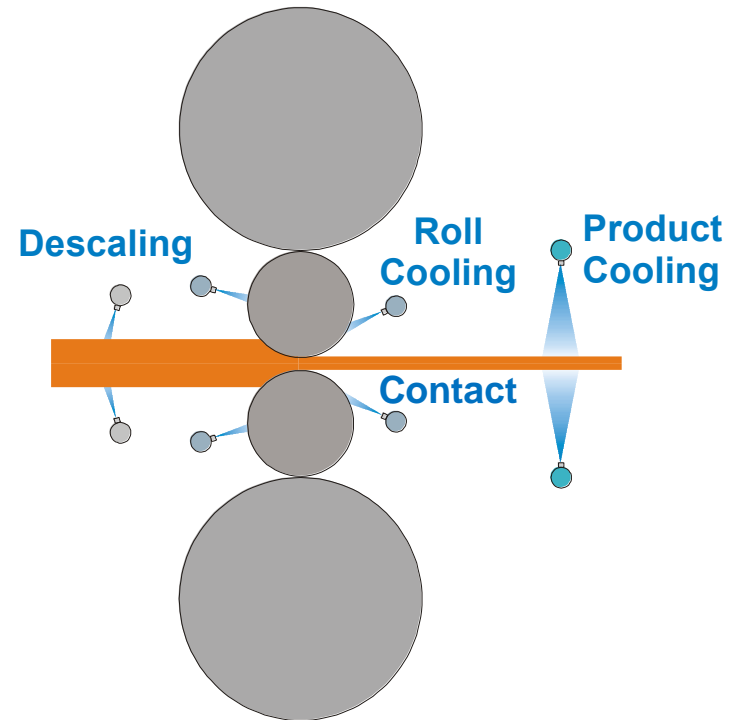
Heat Transfer and Fluid Flow Laboratory

Experimental research of heat transfer and heat treatment

Numerical models of continuous casting, rolling and heat treatment



Continuous Casting

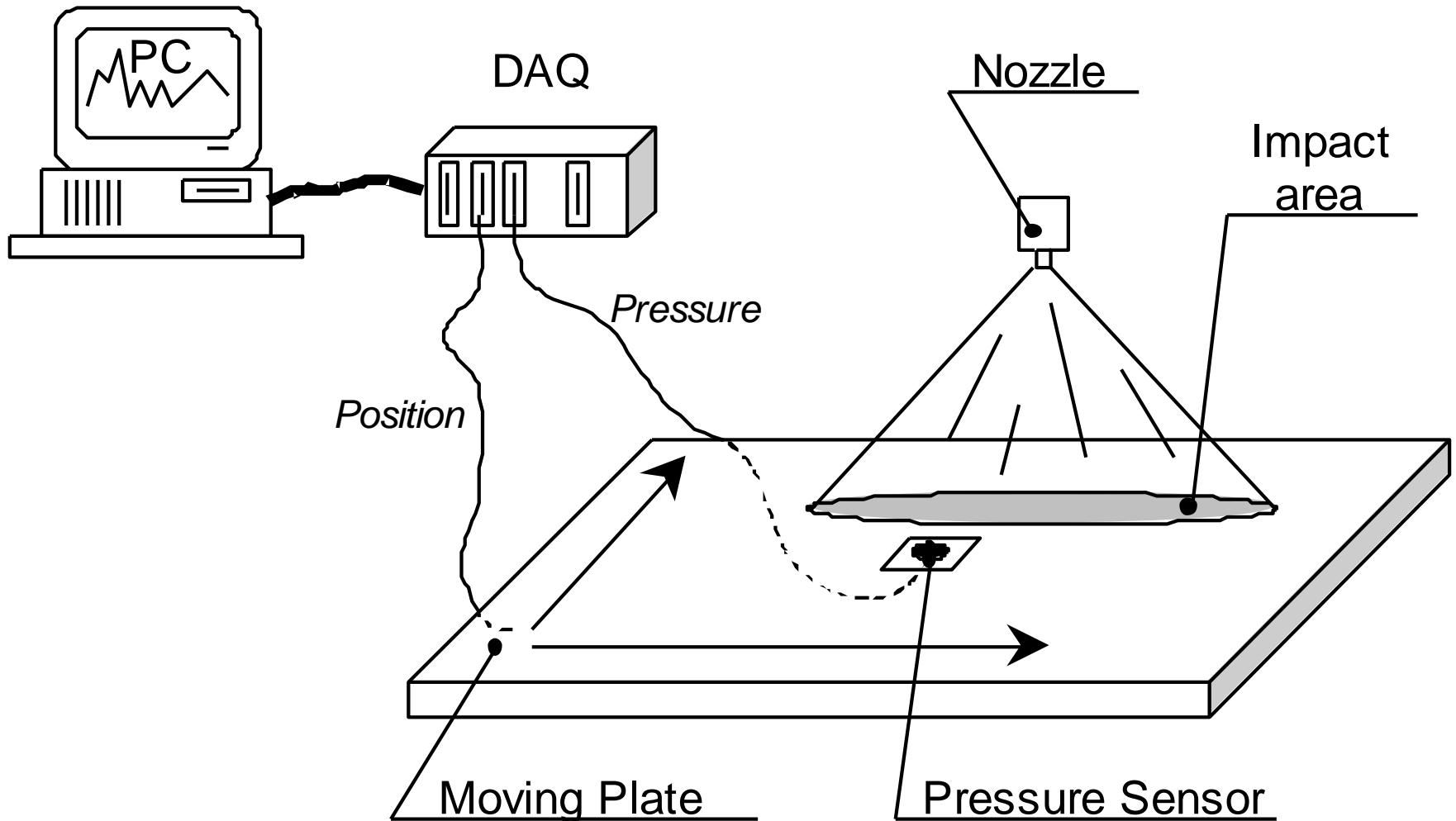


Rolling and heat treatment

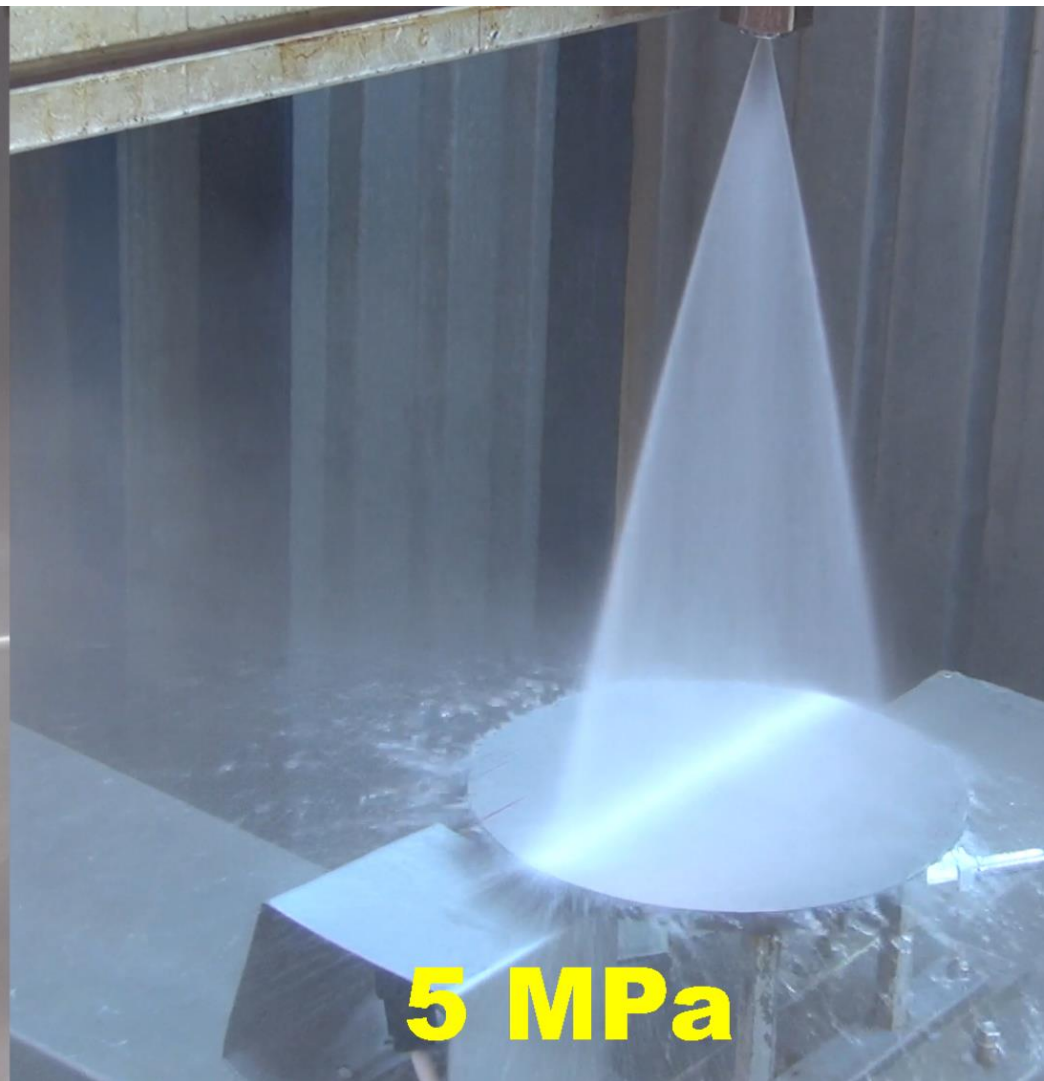
Descaling of coils of wires – outer diameter 1.4 m



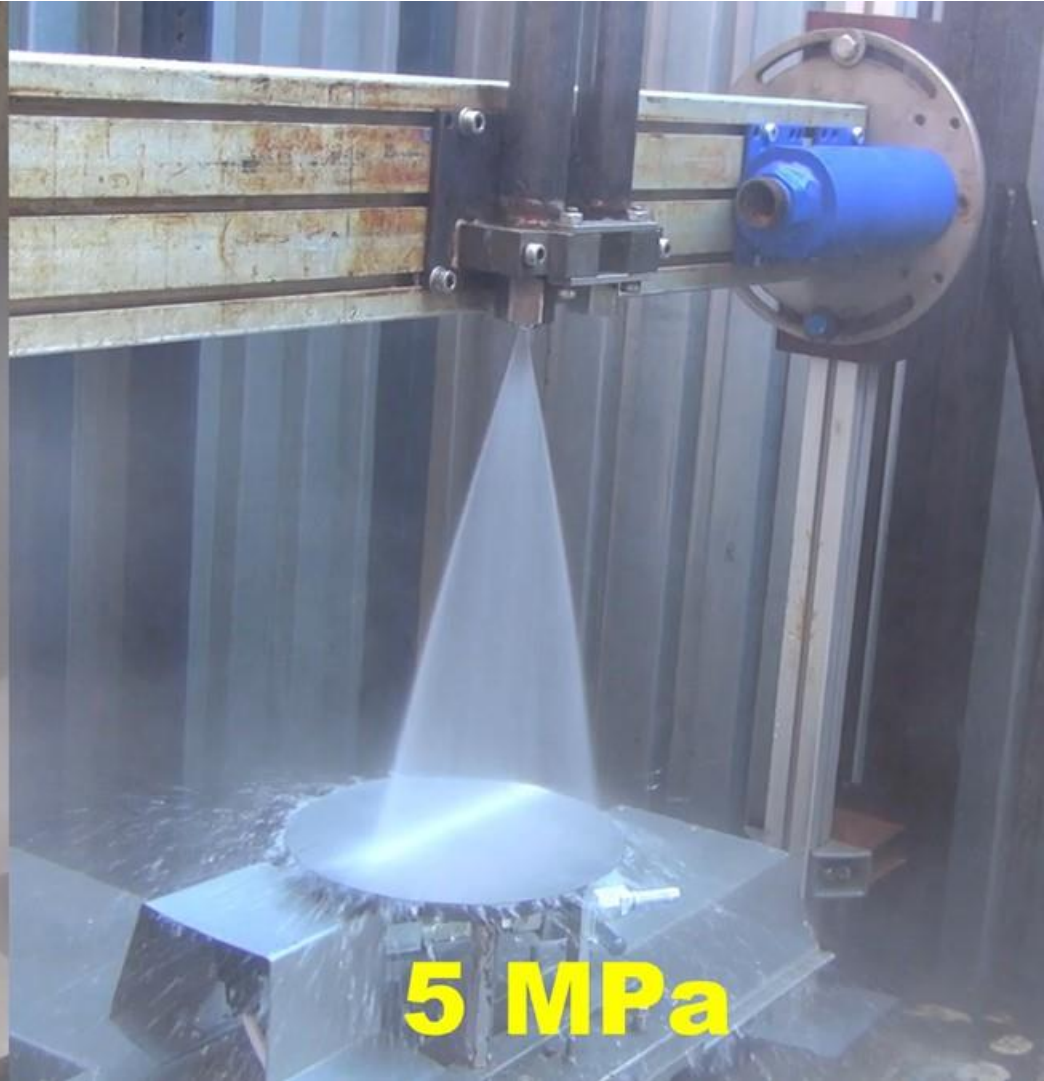
Impact pressure distribution measurement



Spray comparison – High and low pressure but same water flow rate



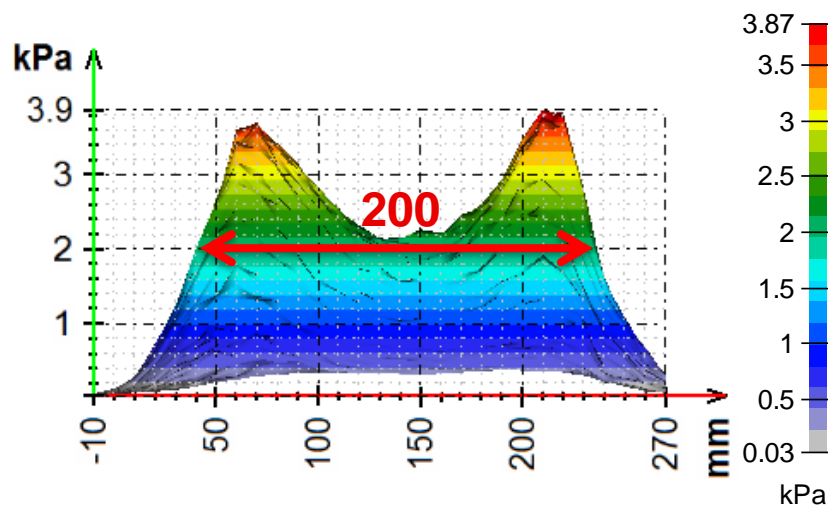
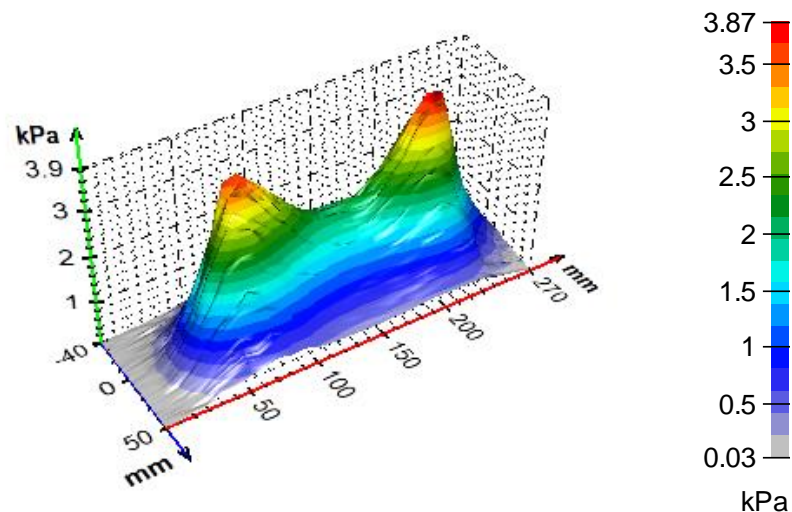
Spray comparison – High and low pressure but same water flow rate



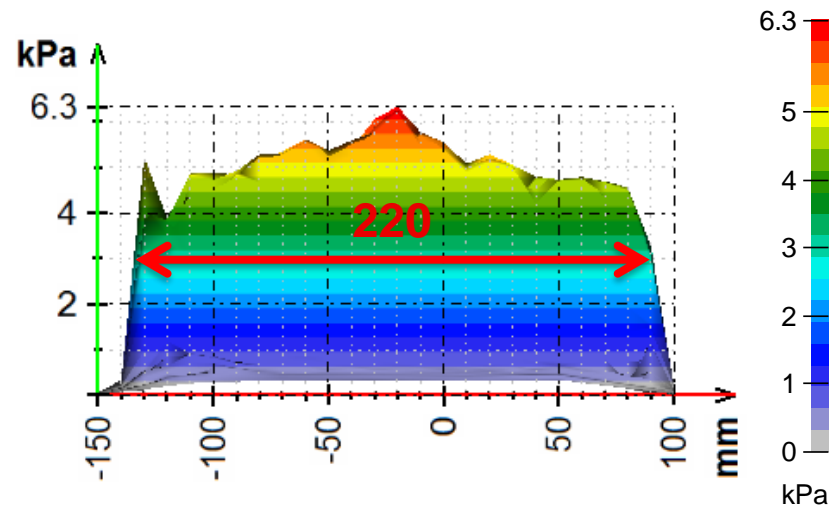
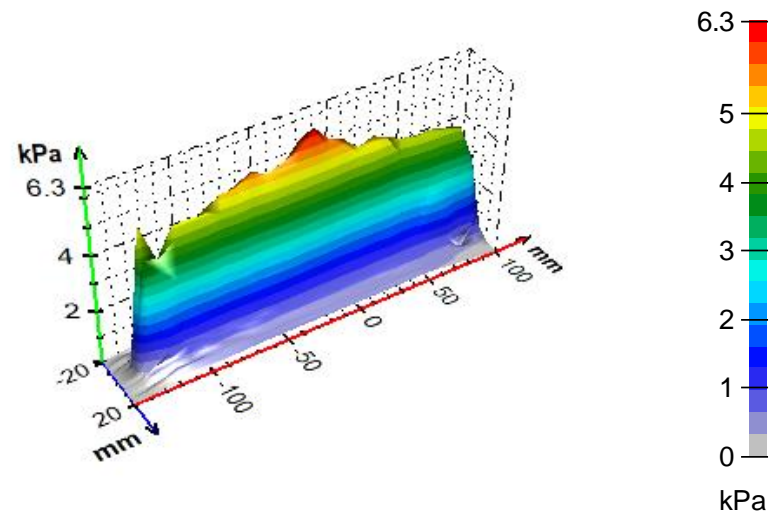
Video

Distance 300 mm - No wires

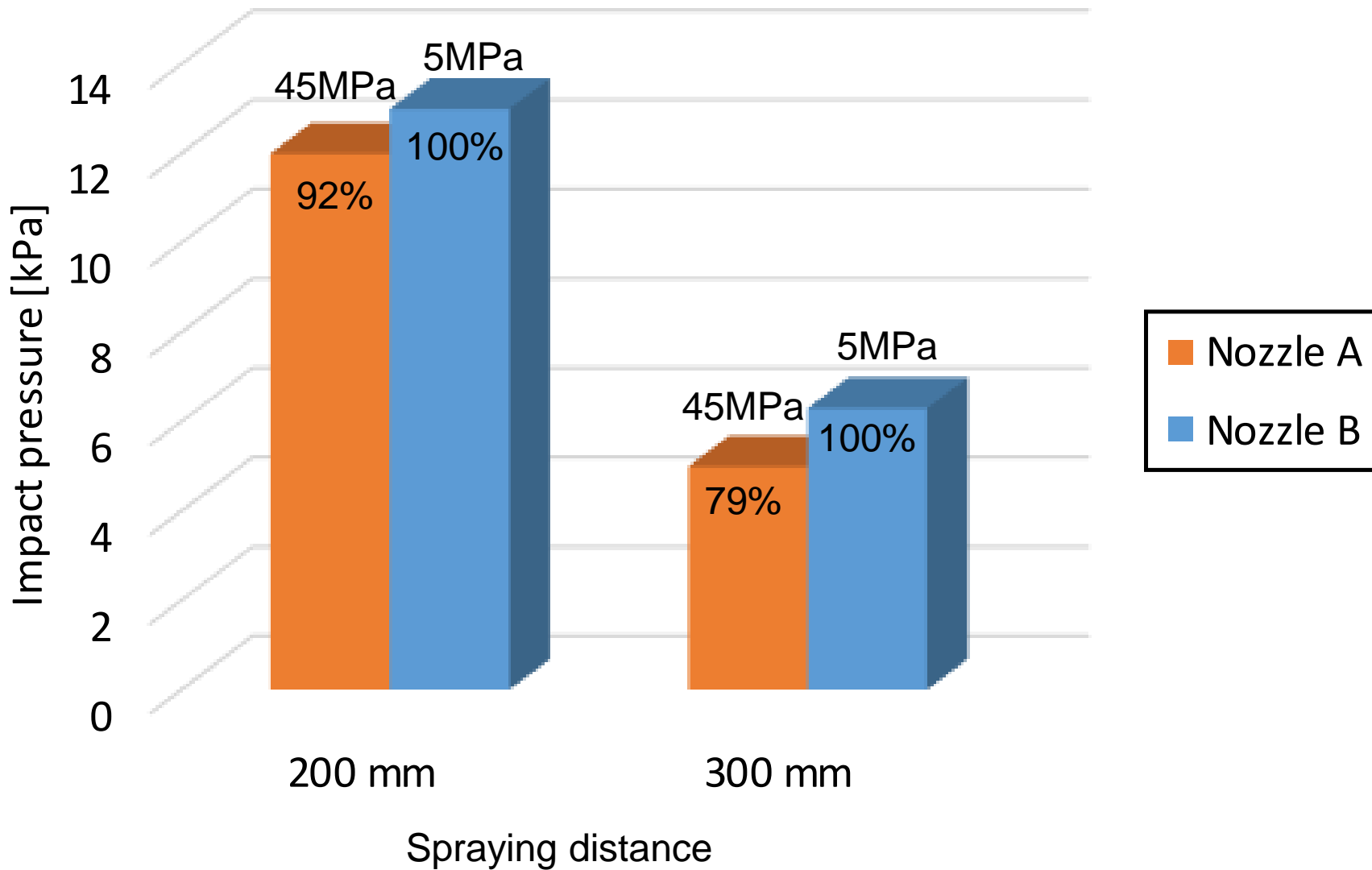
Nozzle A at 45 MPa
Catalogue spray angle 45°



Nozzle B at 5 MPa
Catalogue spray angle 40°



Impact pressure measurements without dummy wires



Cleaning graphite coating

Nozzle A at **45 MPa**



Nozzle B at **5 MPa**



Cleaning graphite coating - Video



Impact pressure distribution while spraying through wires



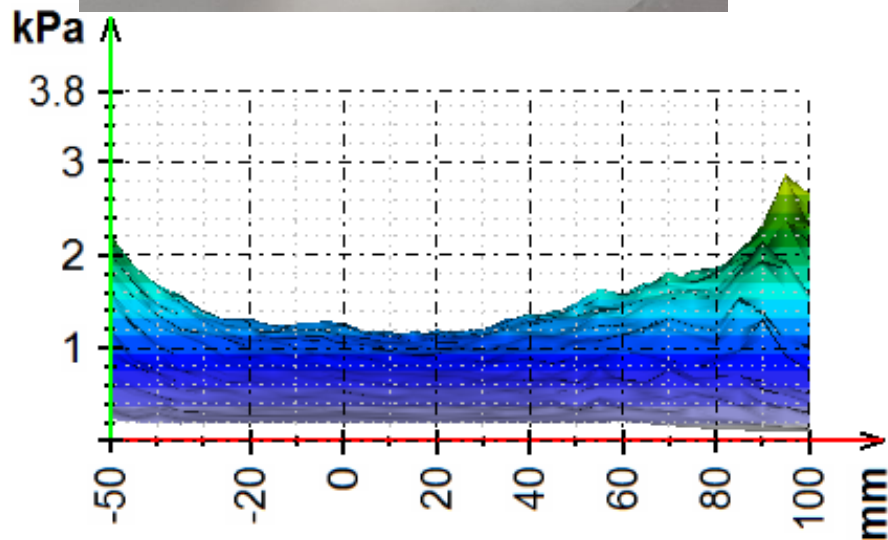
1 layer



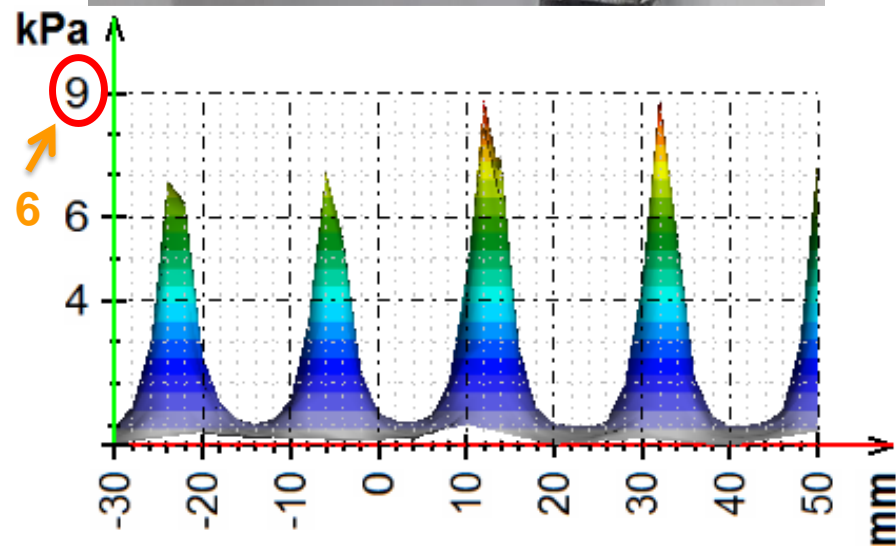
6 layers

One layer of wires

45MPa



5MPa

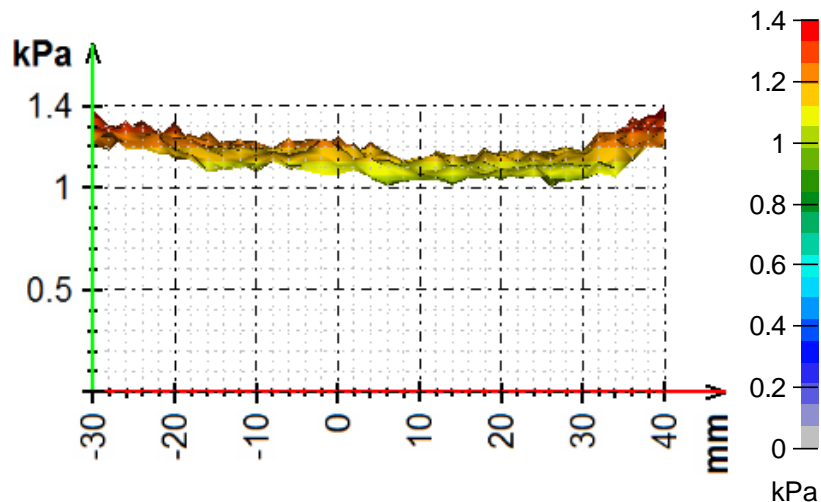


Distance **300** mm - with 6 layers of wires – 5 MPa

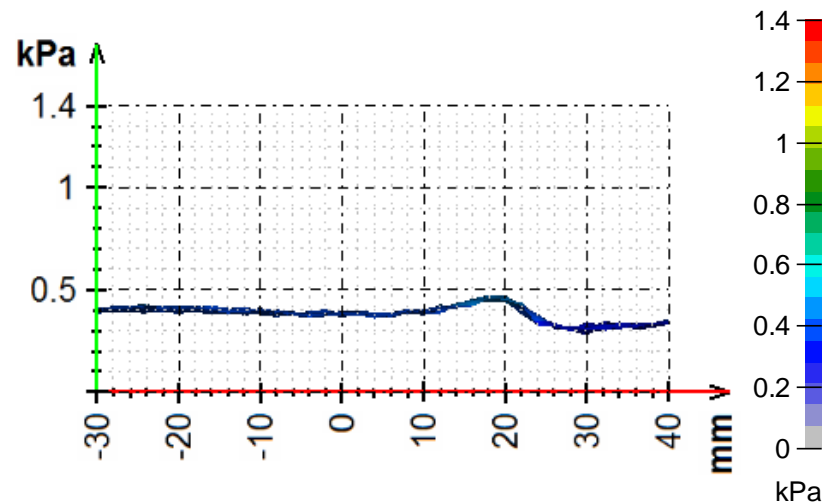


Distance 300 mm - with 1-6 layers of wires – smaller nozzle, 45 MPa

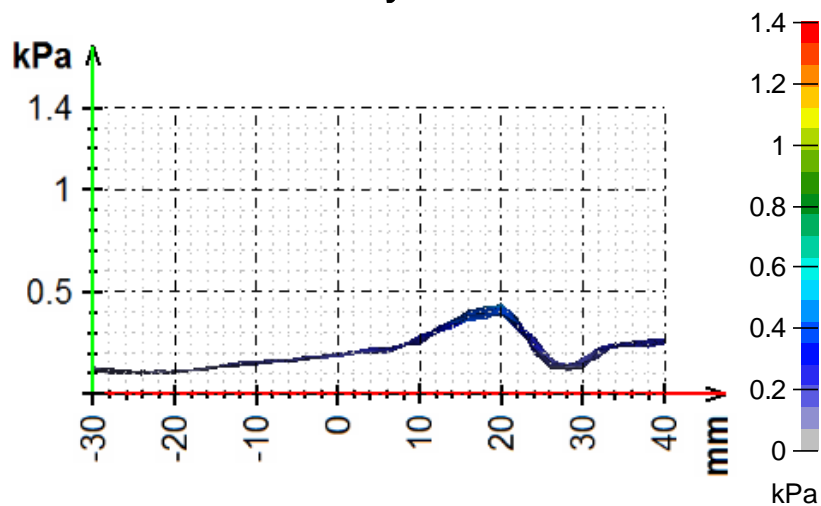
1 layer



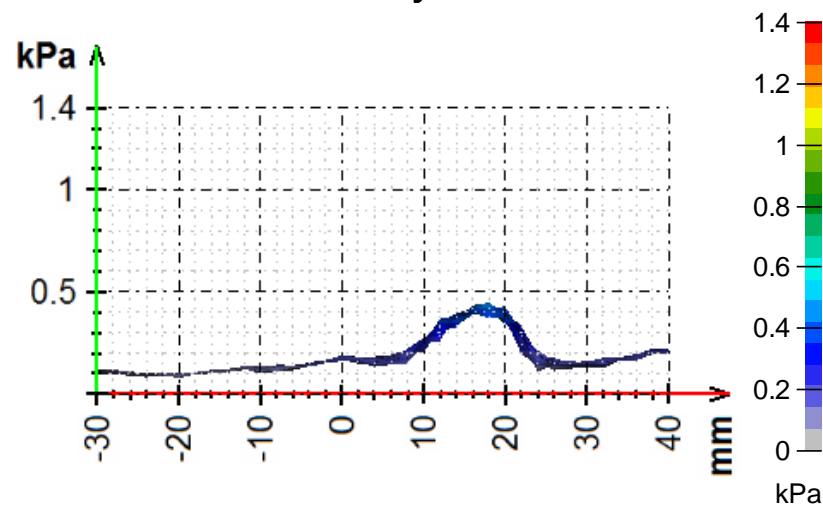
2 layers



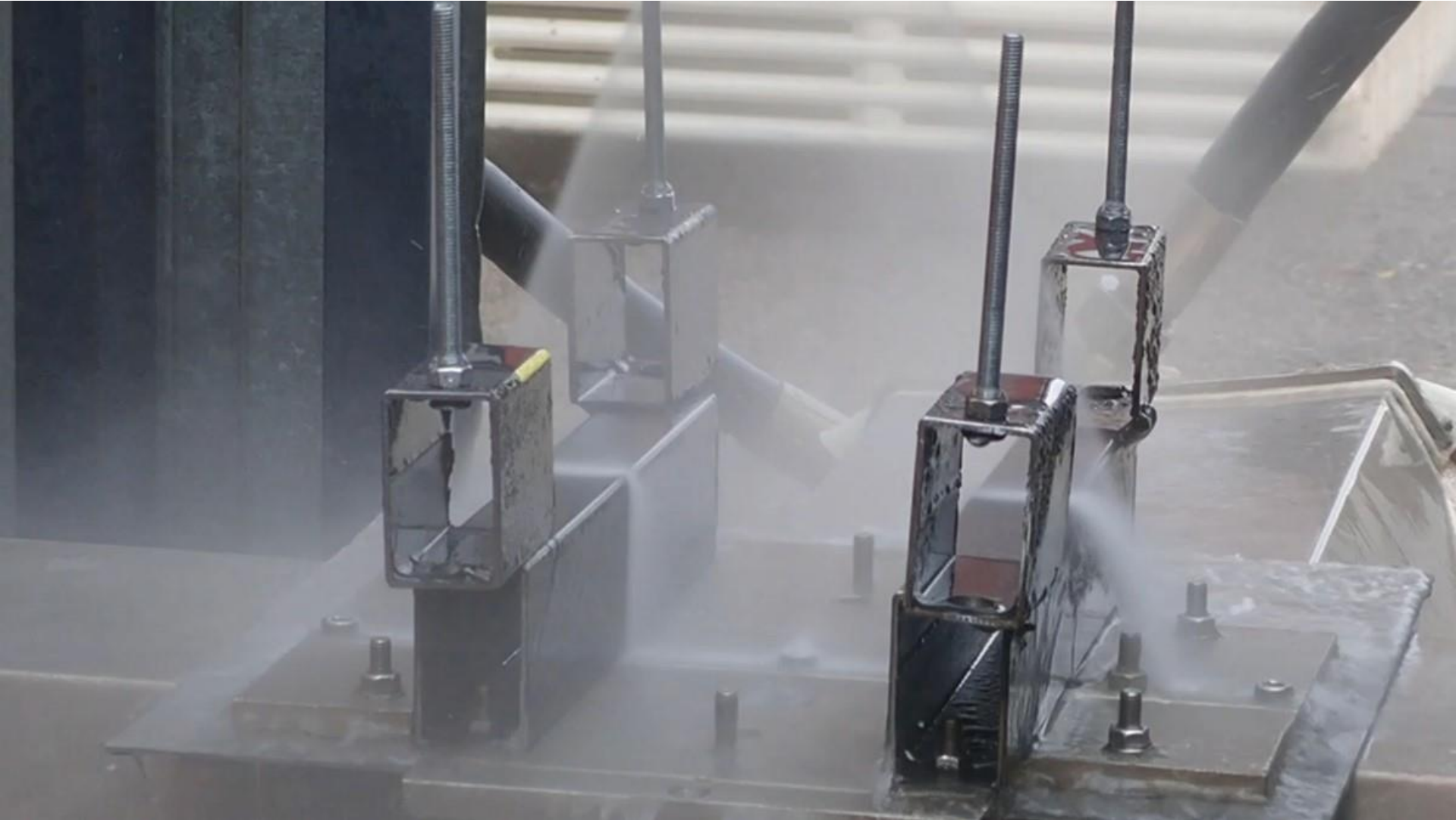
4 layers



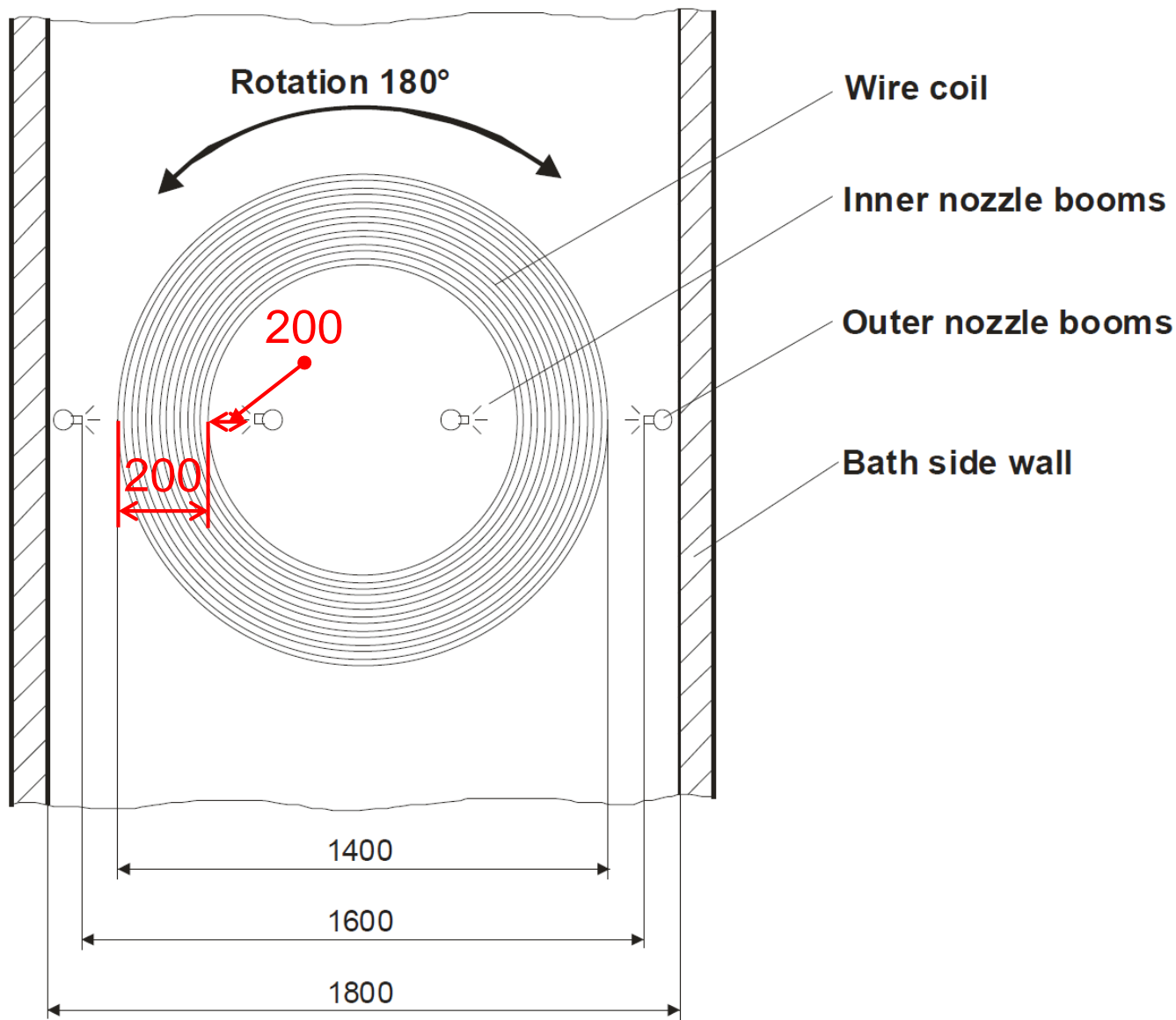
6 layers



Distance 300 mm - with 1-6 layers of wires - Video



Spray distances during hydraulic descaling

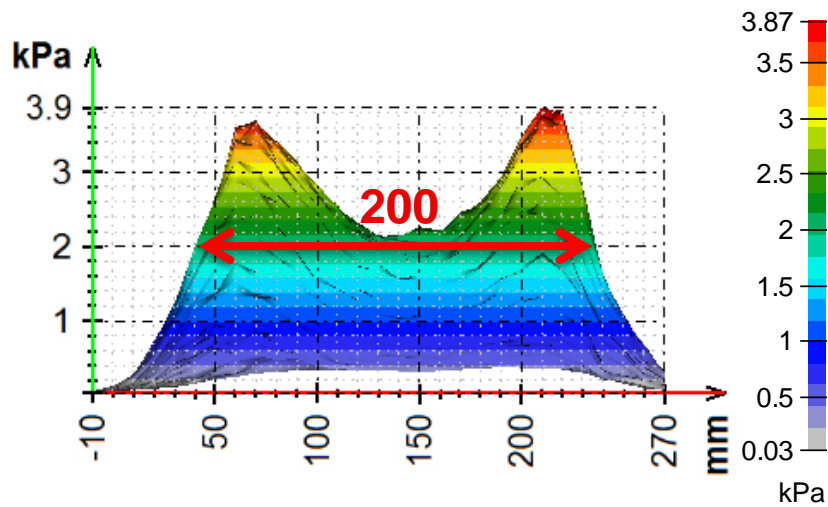


Distance of descaling header from wires is 200 mm

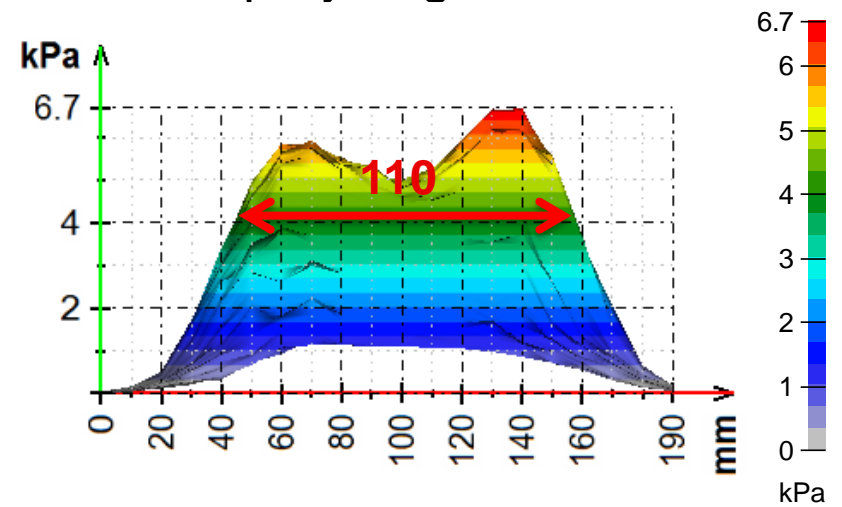


Reduced spray angle

Spray angle 45°



Spray angle 30°



Hydraulic descaling

Wire descaling using smaller nozzle at 45 MPa for steel grade 1.4571

before
descaling



after
descaling
from
300 mm



after
descaling
through
dummy
wires from
300 mm



after
descaling
from
200 mm

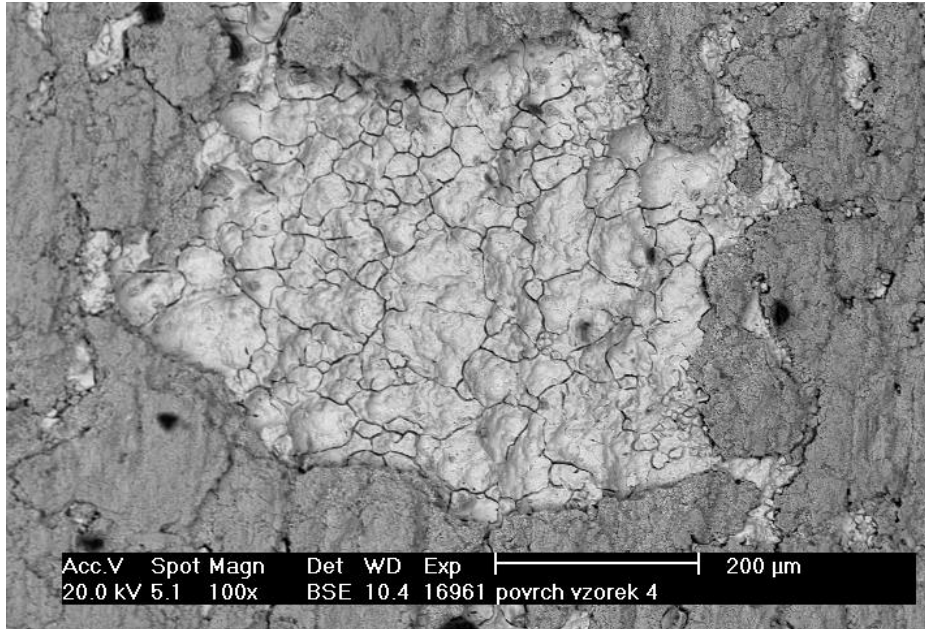


** This is not the final surface of the product. This is surface during pickling program.*

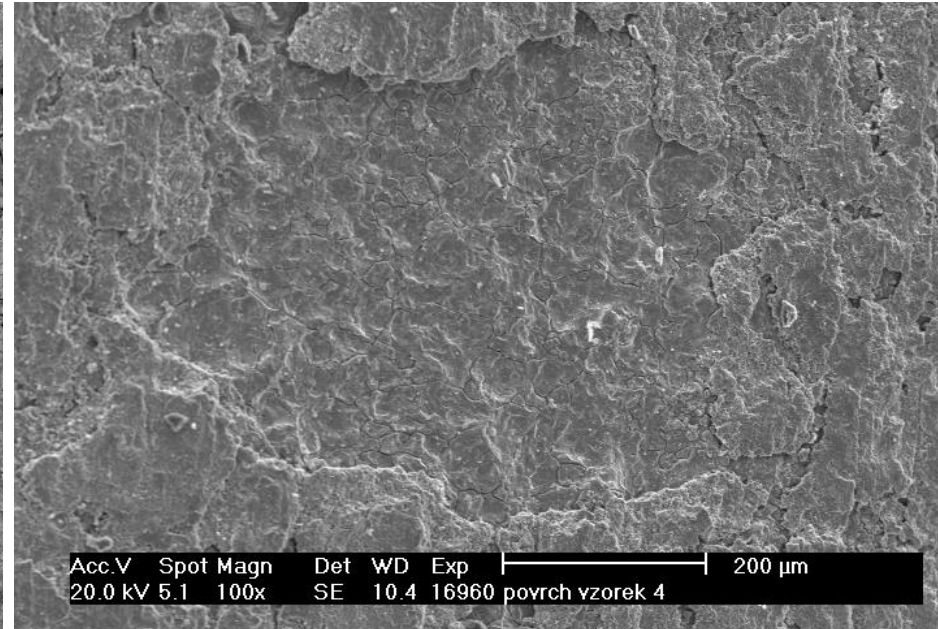
EDX Analysis with a Scanning Electron Microscope



EDX Analysis with a Scanning Electron Microscope



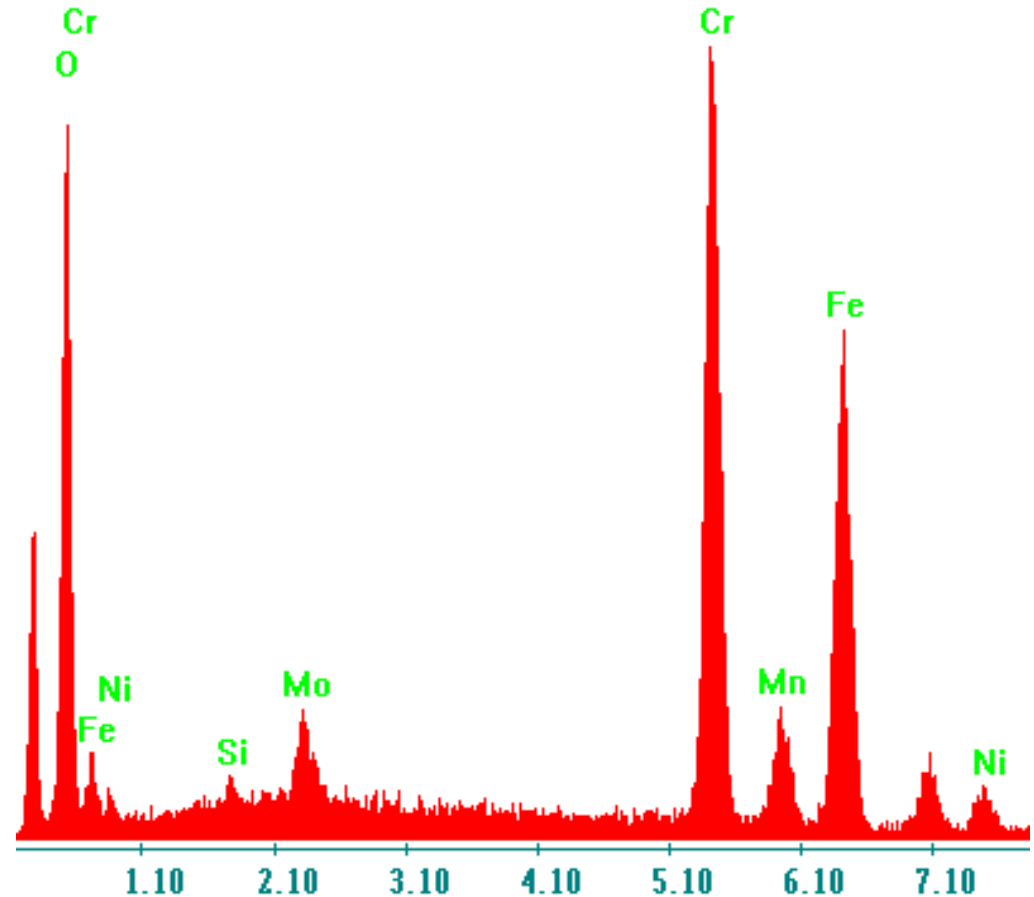
backscattered (BSE)



secondary electrons (SE)

EDX Analysis with a Scanning Electron Microscope

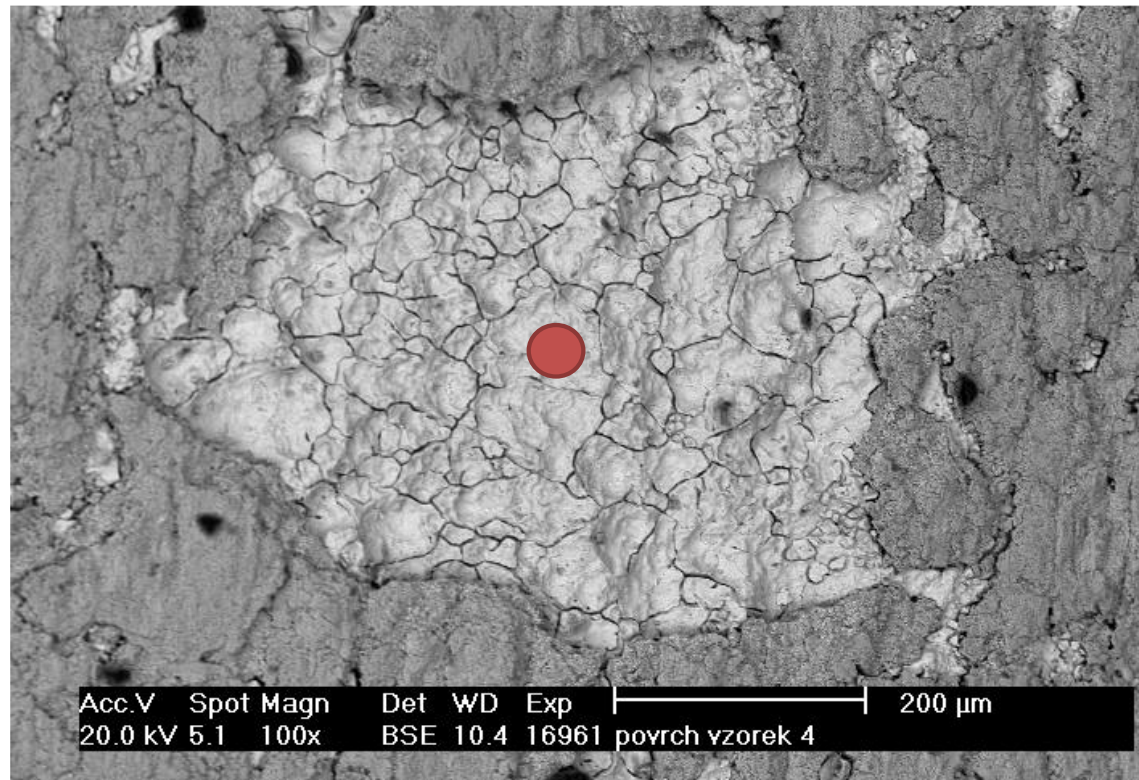
Element	Wt %	Inte. Error
O	27.8	1.4
Si	0.4	16.0
MoL	3.9	4.7
Cr	32.2	1.0
Mn	0.3	29.4
Fe	31.3	1.3
Ni	4.0	5.3



EDX Analysis with a Scanning Electron Microscope

Steel grade 1.4404

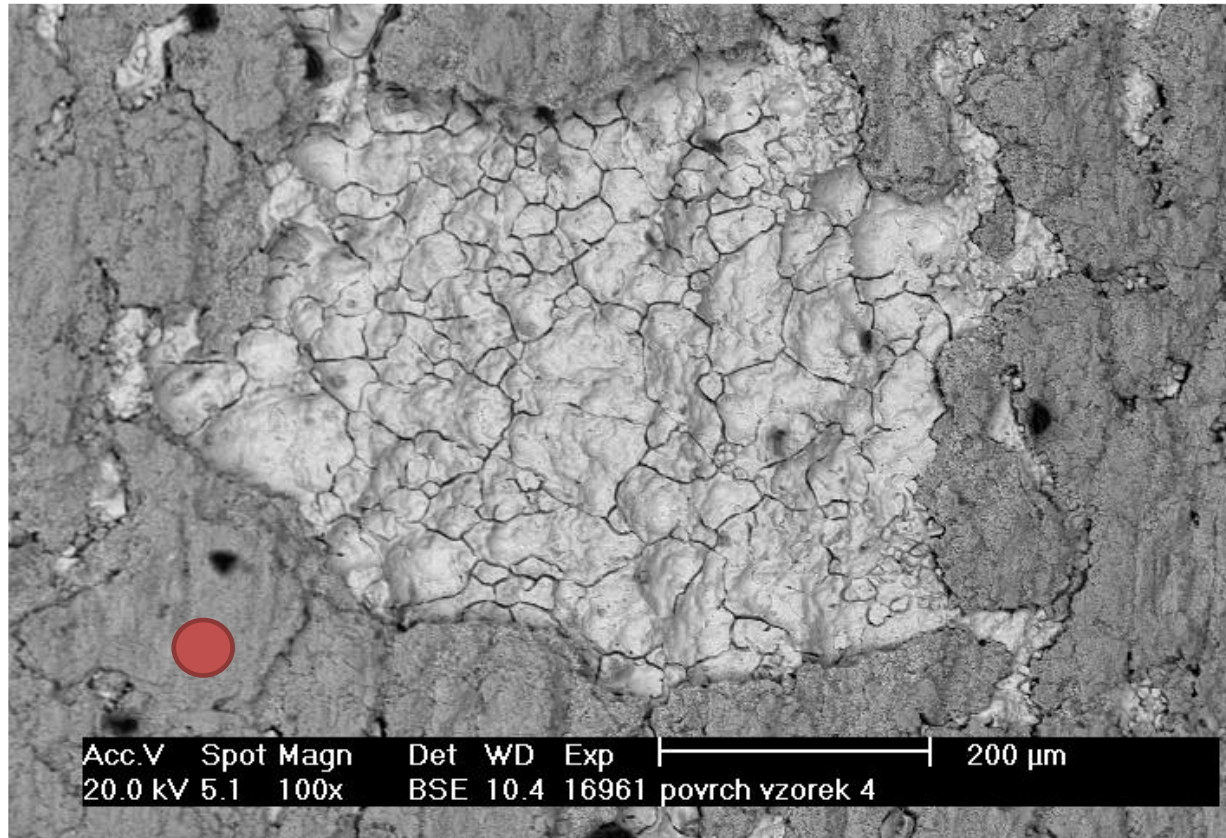
	Fe	Cr	Ni	Mo	Mn	Si
Data sheet		16.5–18.5%	10–13%	2–2.5%	≤ 2%	≤ 1%
Measured	66.4%	17.6%	11.1%	2.9%	1.3%	0.8%



EDX Analysis with a Scanning Electron Microscope

Scale layer on 1.4404

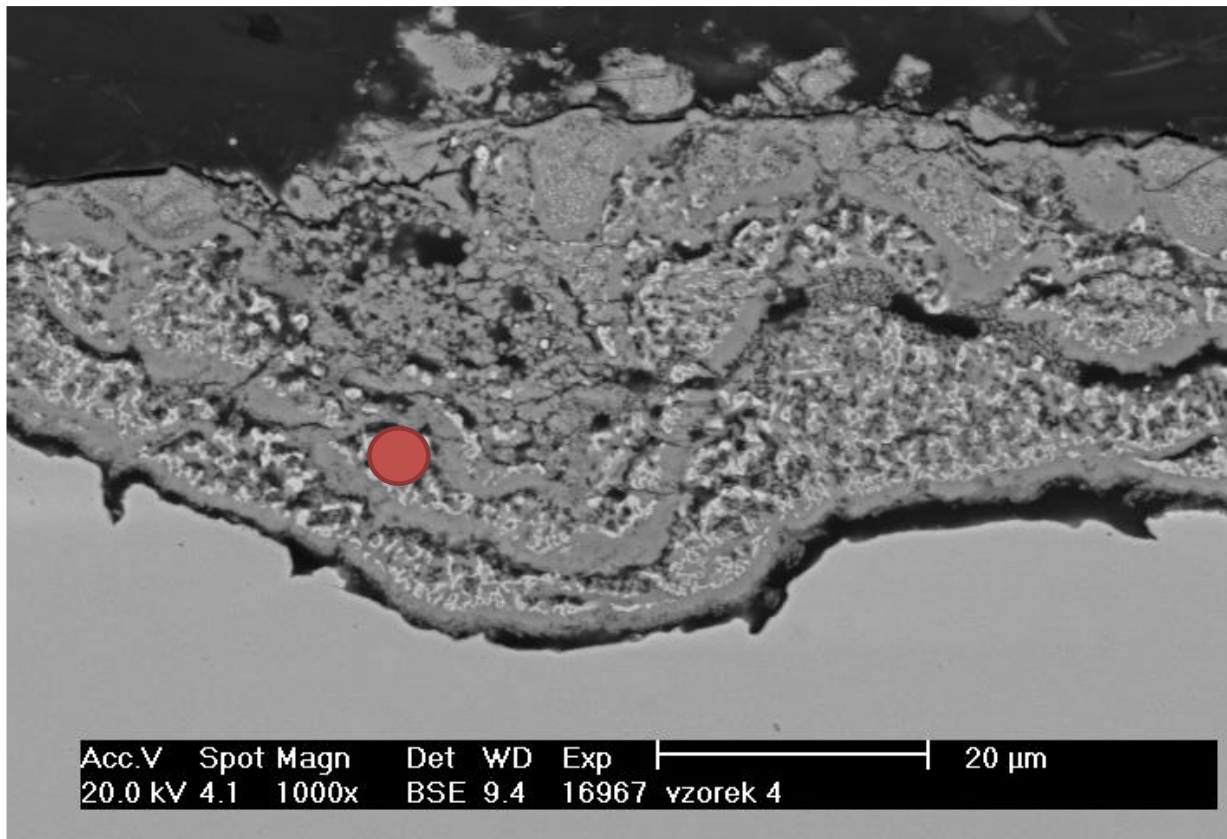
	Fe	O	Cr	Ni	Mo	Mn
Measured	31.3%	27.8%	32.2%	4.0%	3.9%	1.3%



EDX Analysis with a Scanning Electron Microscope

Scale layer on 1.4404

	Fe	O	Cr	Ni	Mo
Measured	32.7%	20.8%	28.7%	13.5%	4.0%





Conclusion

- Big spraying distance (200 mm and more)
 - **Free space**
→ Use **bigger nozzle** and **smaller pressure**

 - Spraying **through wires**
→ Use **smaller nozzle** and **bigger pressure**

- Hydraulic descaling is effective during pickling.

Thank you for your attention...

www.heatlab.cz