



Coke Cutting of large Drums

Coking.com Safety Seminar

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RUHRPUMPEN



Slide 1

P1

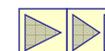
Paul, 6/24/2009

Agenda

- ◆ **Process and Drum data**
 - ◆ 1980 to 2012
- ◆ **Data of Coke Cutting Pump**
 - ◆ 1980 to 2012
- ◆ **Coke Cutting Equipment and Pull Force**
 - ◆ Weight of Coke Cutting Equipment
 - ◆ Pull Force, required for large drums
 - ◆ Specific Pull Force
- ◆ **Coke Cutting Analysis and Verification**
 - ◆ Jet Pump
 - ◆ Cutting Equipment
- ◆ **Conclusion**

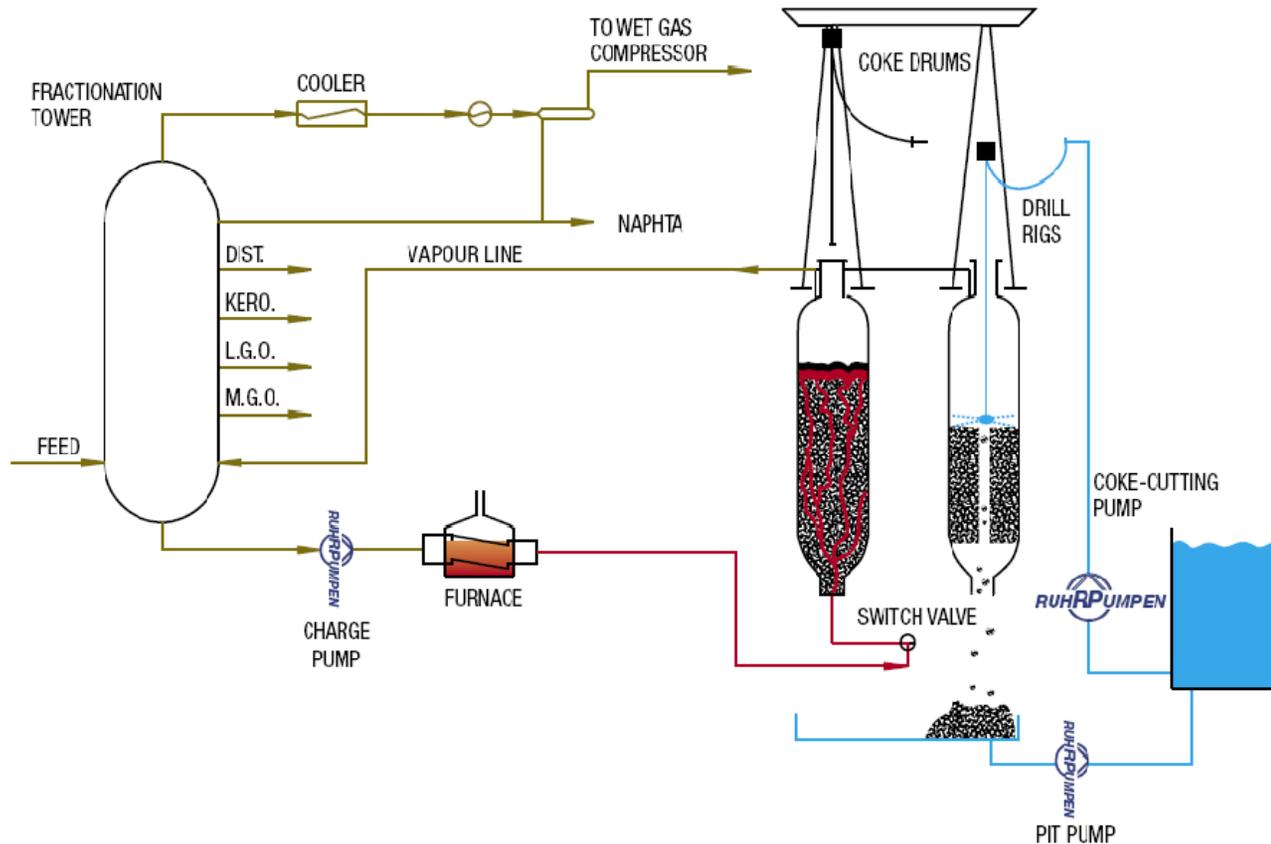
Ruhrpumpen – References, systems

Year	company	drums	scope	type
2001	Petrolera Ameriven, Venezuela	4 x 29'	Complete HDS, hydraulic	new
2002	BP-Gelsenkirchen, Germany	4 x 26'	Cutting system, electric + semi automated top deheading semi automated bottem deheading	revamp
2003	BP – Lingen, Germany	2 x 17'	Cutting system, hydraulic 36" top deheading valves semi-automated bottom dh	new
2004	Jinling, China	2 x 31'	Jet Pump and decoking Valve	new
2005	CNRL, Canada	4 x 30'	Complete HDS, elec/hyd	new
2005	ENERCON, Chile	2 x 29'	Complete HDS, hyd	new
2005	BP-Lingen, Germany	2 x 17'	Cutting system, hyd 30" top deheading valves semi-automated bottom dh	revamp
2006	BP Castellon, Spain	2 x 25'	Complete HDS, hyd + 30' top deheading valves	new
2006	Sinclair Oil, USA	2 x 26'	Cutting system, hyd	revamp
2006	Sinopec, CNOOC, China	4 x 32'	Jet Pump and DC-valve	new
2007	suncor, Canada	6 x 32'	Complete HDS, elec	new
2007	Frontier, CB&I, USA	2 x 26'	Complete HDS, elec	revamp/new
2007	OMV, Germany	2 x 26'	Jet Pump and Decoking valve	revamp
2007	Rosneft, Komsomolsk, Russia	2 x 26'	Complete HDS, elec	new
2007	Lukoil, Volgograd, Russia	3 x 18'	Complete HDS, elec	revamp
2007	Petro Canada, Montreal, Canada	2 x 28'	Complete HDS, elec	new
2007	<i>Petro Canada, Fort Hills</i>	<i>4+2x32'</i>	<i>Complete HDS, elec</i>	<i>new, canceled</i>
2007	Hunt Ref., USA	2 x 28'	Cutting system, elec	extension
2008	HMEL, India	4 x 30'	Complete HDS, elec	new
2009	StaoilHydro, MWKellog	2 x 26'	Cutting system, elec	revamp



Process

COKER-DECOKER-ARRANGEMENT



Pump requirement

Coke Cutting Pump

Medium: Water

$Q = 300 \text{ m}^3/\text{h}$

$H = 3.500 \text{ m}$

$T = 75 \text{ }^\circ\text{C}$

Heater Charge Pump

Medium: Hot oil

$Q = 400 \text{ m}^3/\text{h}$

$H = 400 \text{ m}$

$T = 250 \text{ }^\circ\text{C}$

Pit Pump

Medium:

Water with coke fines

$Q = 600 \text{ m}^3/\text{h}$

$H = 40 \text{ m}$

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

Coker unit



Refinery
with
Delayed Coker

Coke Drums

Dia = 29'; 8,90 m
FF = 121'; 36,88 m

Coke Cutting Pump

Medium: Water

Q = 300 m³/h
1200 gpm

H = 3.200 m
4.425 psi

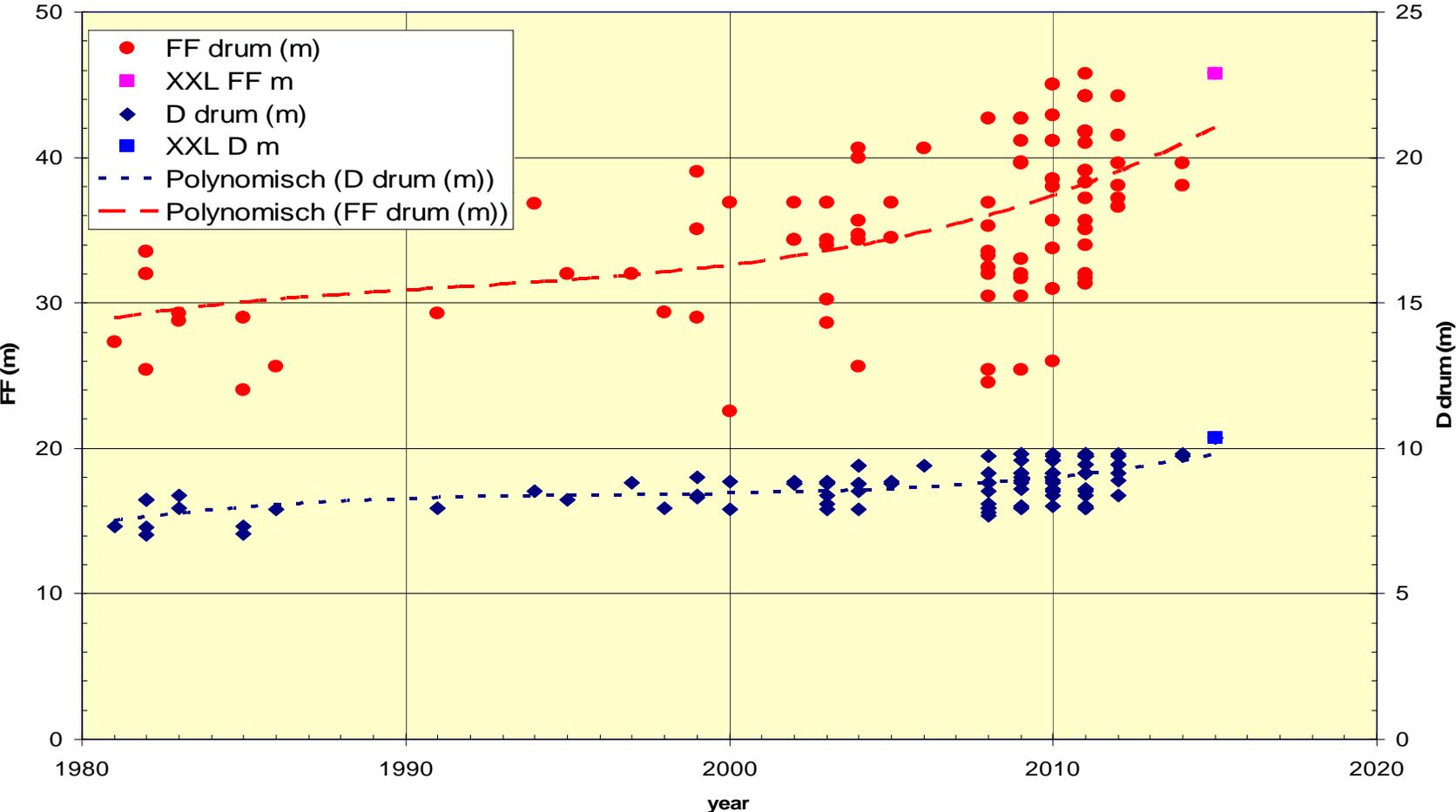
T = 75 °C
140 °F

Definitions

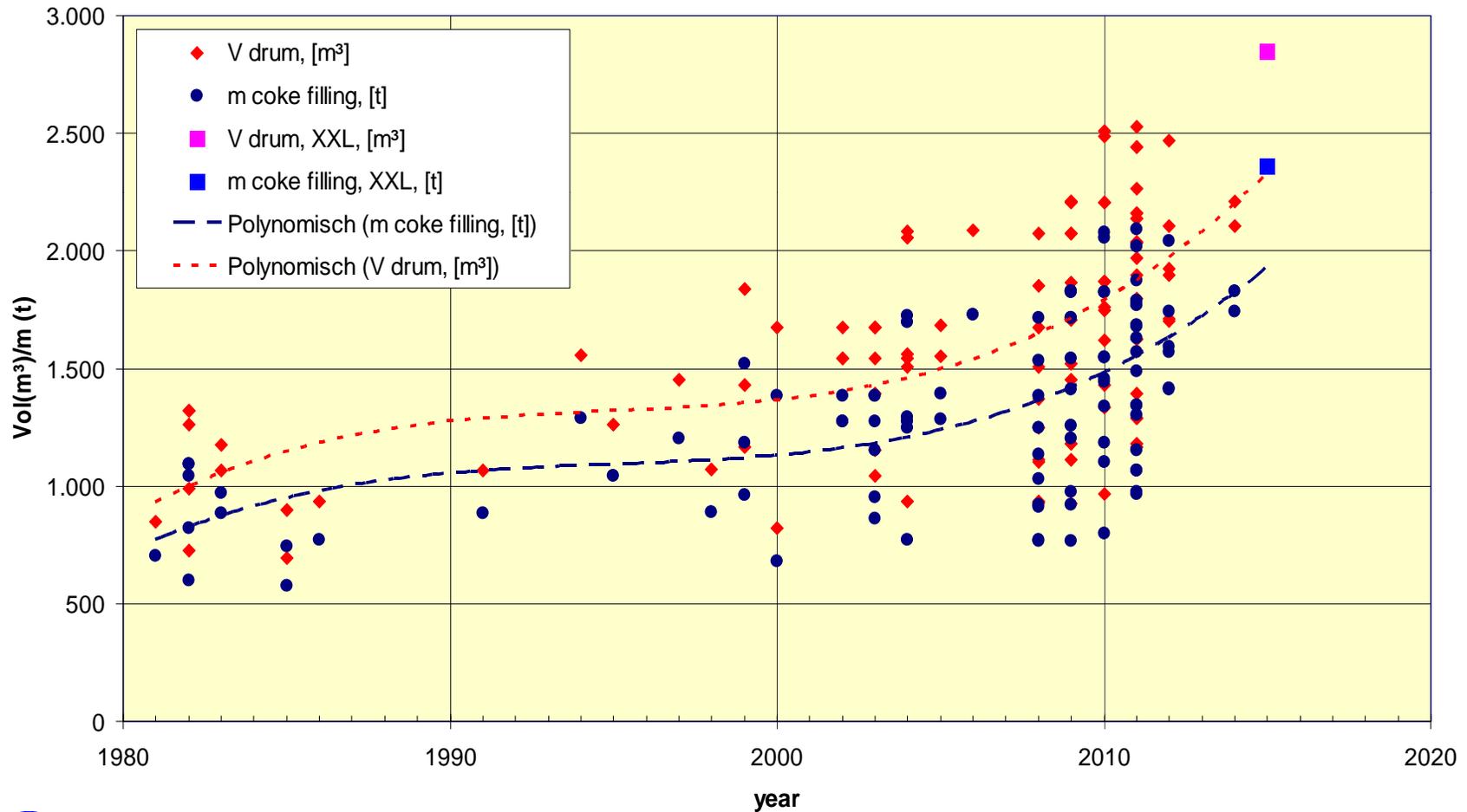
Parameterization

- ◆ $C_{Vol\ drum}$ = $\frac{Vol_{drum}}{Vol_{Cylinder}}$ 0,74 ... 0,82
- ◆ C_{coke} = $\frac{m_{coke\ design\ filling}}{m_{coke\ full}}$ 0,70 ... 0,83
- ◆ $C_{coke\ type\ cutting\ factor}$ / 1,0 / 0,80 = needle / anode grade / fuel grade / shot 1,3 / 1,1
- ◆ $C_{coke\ cut\ time}$ = $\frac{T_{cut\ time\ [hrs]}}{T_{Standard\ (4\ hrs)}}$
- ◆ $C_{daily\ prod\ pair}$ = $\frac{1}{(cycle\ time / 24\ hrs)}$ 0,67 => 36 hrs
1,00 => 24 hrs
2,00 => 12 hrs
- ◆ $mc_{cutted\ coke\ hrs}$ [t/hrs] = $\frac{m_{coke\ per\ cycle}}{T_{cut}} = \frac{m_{coke\ per\ day} \times T_{cycle}}{T_{cut} \times 24}$ [t/hrs]

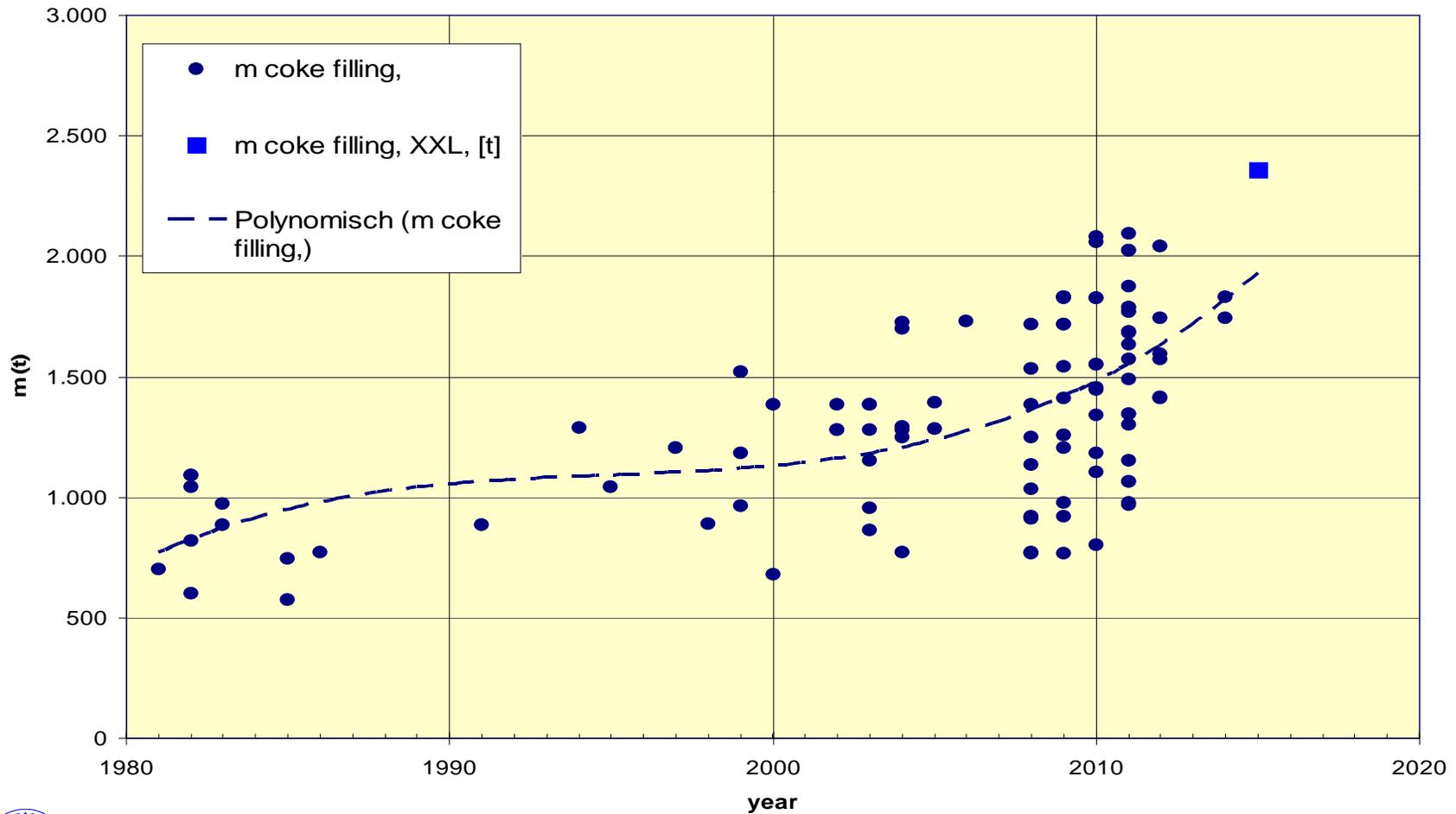
Diameter and Height FF of large Drums



Volume of Drums and Weight of Coke

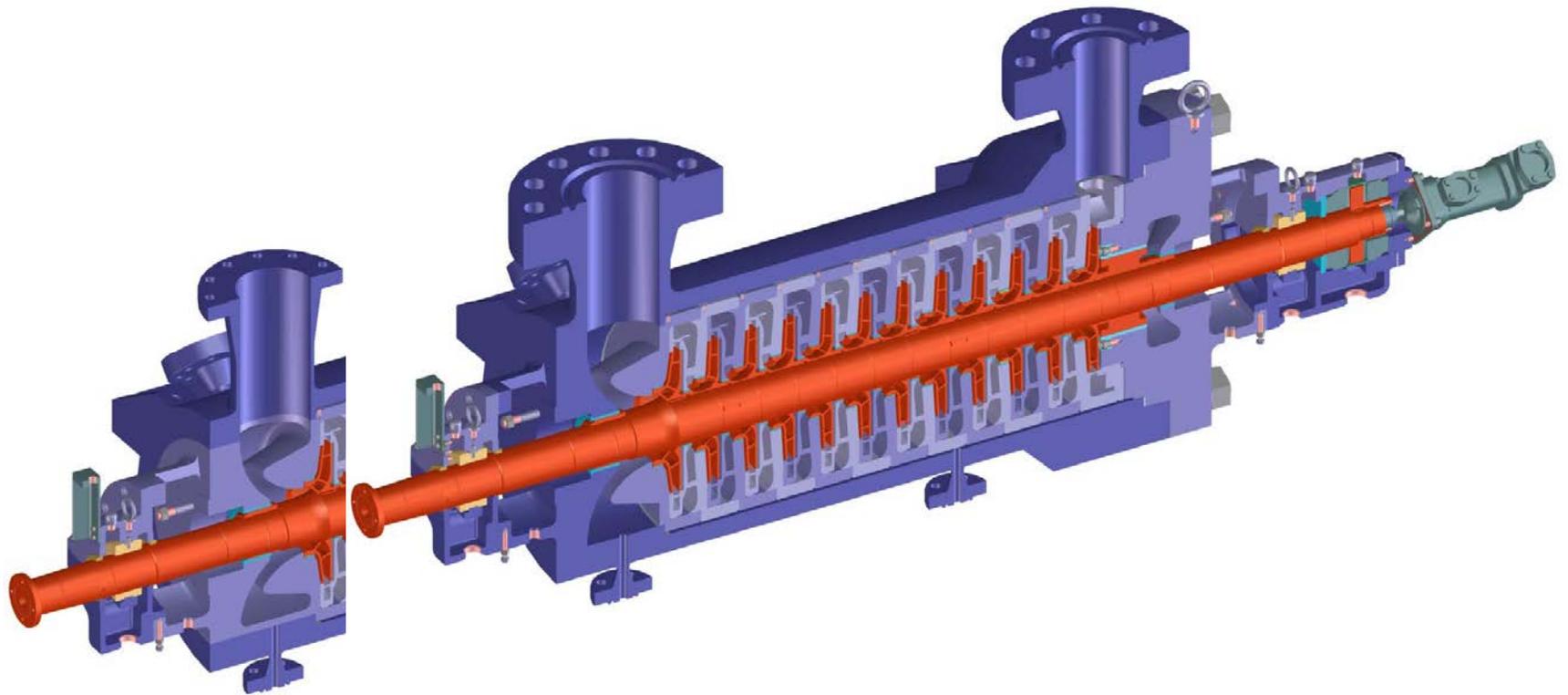


Weight of Coke



Decoking Jet Pump

ADC 6x12



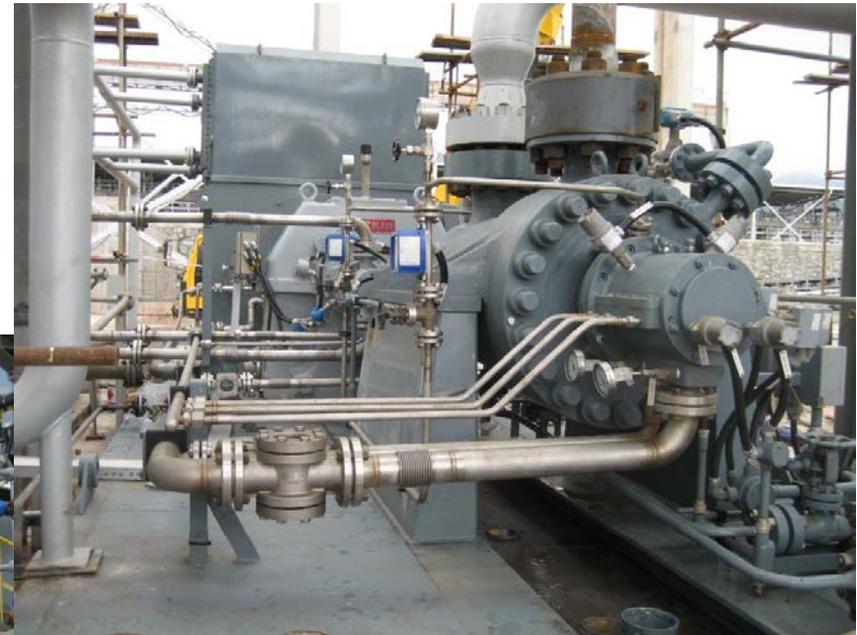
Jet Pump: installations

Example



ADC 6x12
Jose, Venezuela

ADC 6x10
CNOOC, China



ADC 6x10
Castellon, Spanien

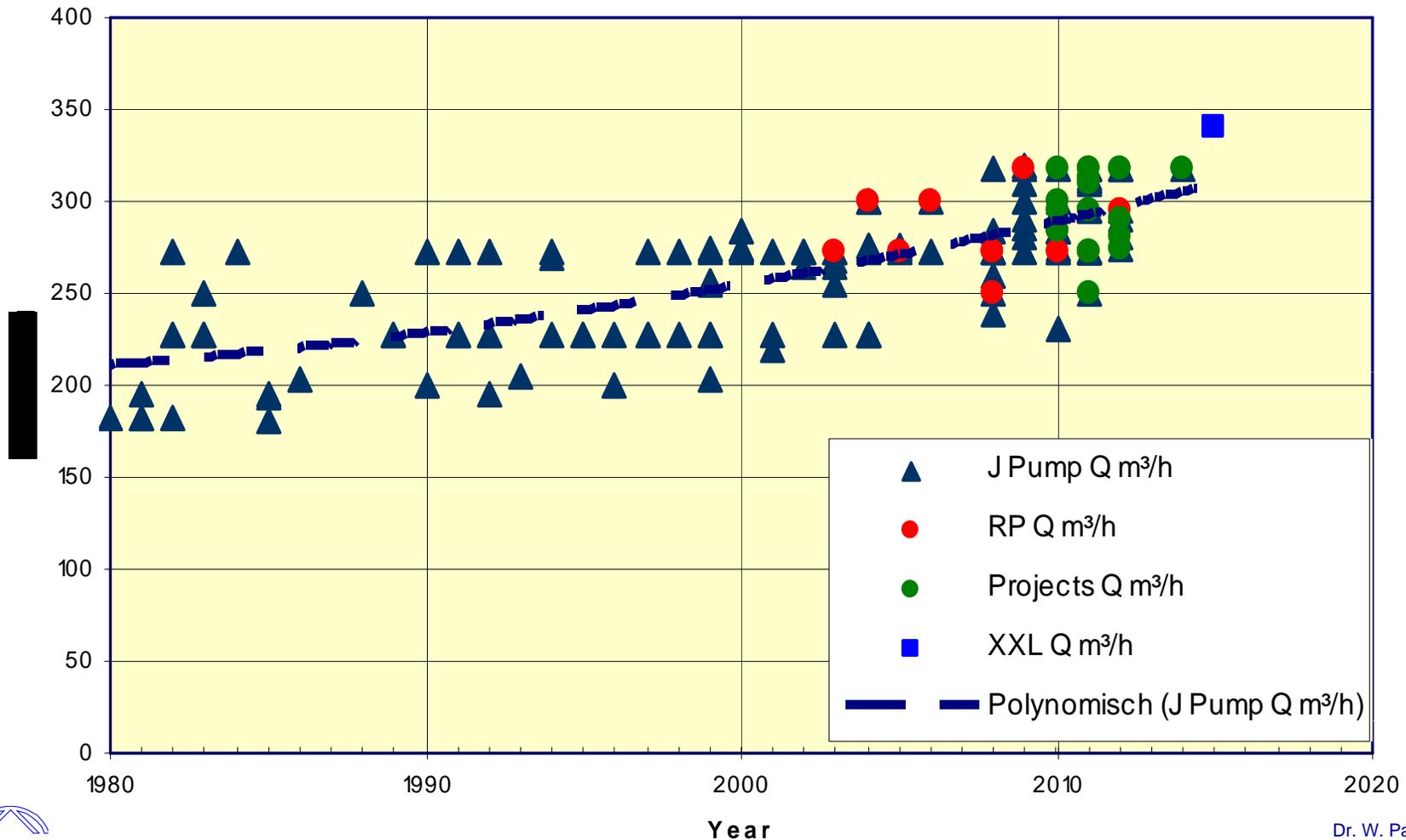
Jet Pump: flow and pressure

Parameterization

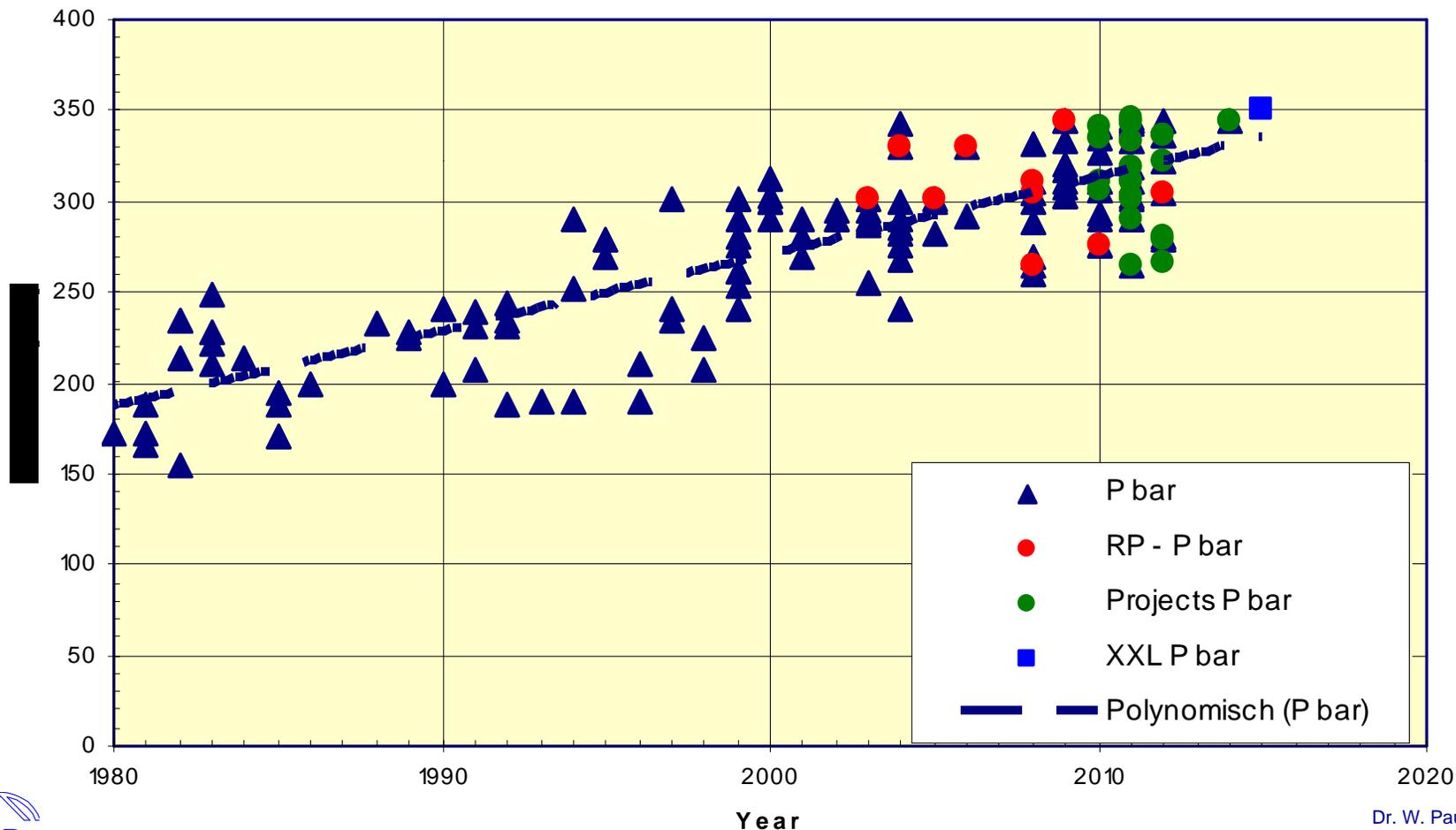
- ◆ Time frame 1980 – now

- ◆ Large drums
 - ◆ without small drums,
 - ◆ without revamps

Jet Pump: flow, large drums



Jet Pump: pressure, large drums



Cutting Equipment: installations

Examples

DSD, elec
CH + FFA,
CNRL,
Canada



DSD, elec
BP-Ge,
Germany



CH + FFA, DSD hyd
BP-Li, Germany

Tool, auto switch
Worldwide, more then 50
installations



Hoist, elec.
Frontier,
USA



Cutting equipment

Weights

◆ Version A

- ◆ Rotary Joint, (Pac, Wor)
- ◆ Crosshead, shoe type
- ◆ Crosshead, rail type
- ◆ Drill Stem 6" OD, till approx. 1995
- ◆ Drill Stem 7" OD, since 1995
 - ◆ 7" OD
 - ◆ Water in Drill Stem
 - ◆ Flanges
- ◆ HP water hose
 - ◆ 3,5" ID water hose
 - ◆ 4" ID water hose
 - ◆ Water in hose
- ◆ Tool auto shift FS/Del
 - ◆ A cross sectional 0,246 m²

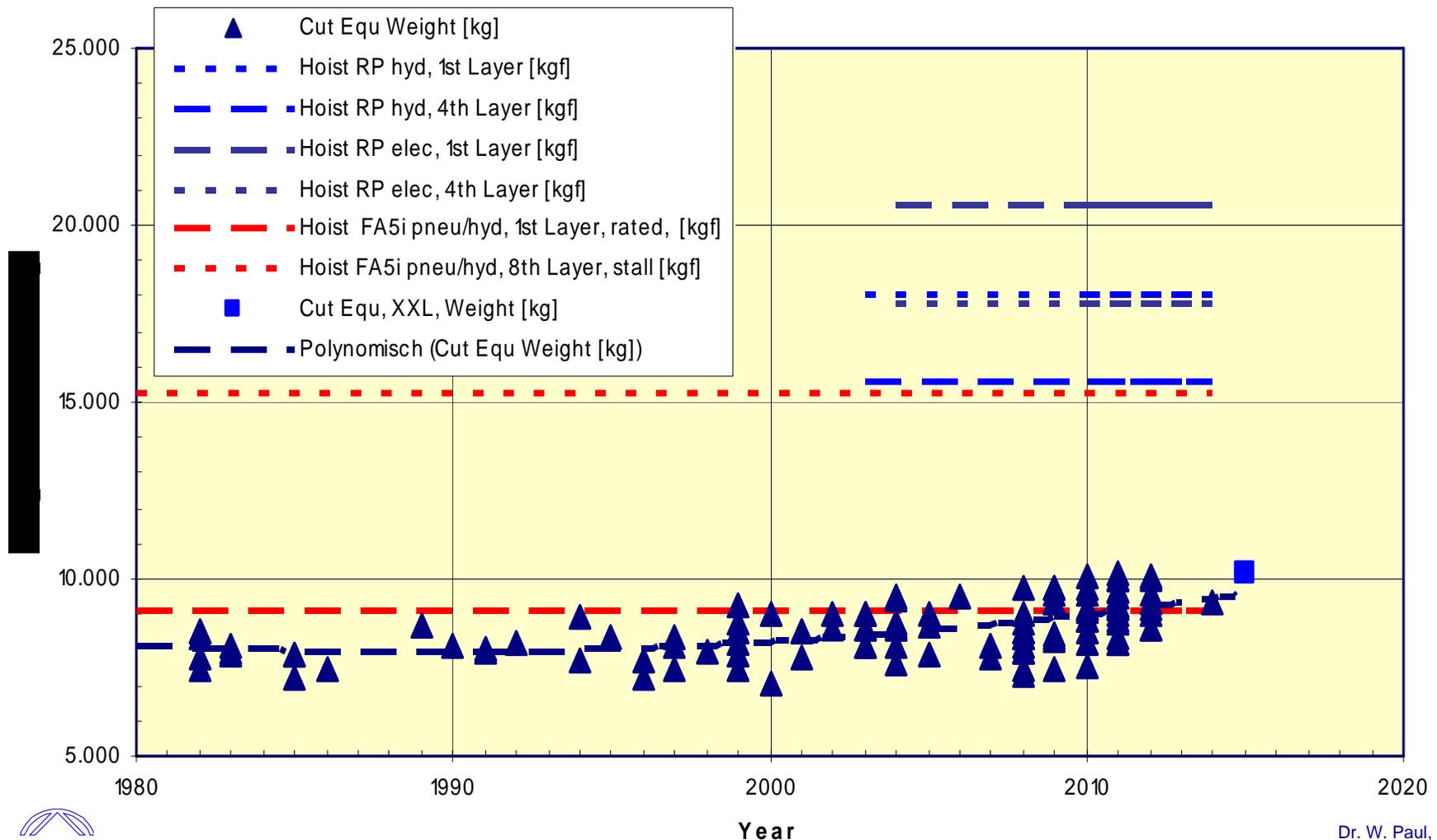
3.875 kg + 135 kg/m
8.540 lbs + 980 lbs/ft

◆ Version Ruhrpumpen

- ◆ Drill Stem Drive DSD, (Ruhrpumpen)
- ◆ Crosshead, rail type with FFA
- ◆ Drill Stem
 - ◆ 7" OD
 - ◆ Water in Drill Stem
 - ◆ Flanges
- ◆ HP water hose
 - ◆ 3,5" ID water hose
 - ◆ 4" ID water hose
 - ◆ Water in hose
- ◆ Tool auto switch
 - ◆ A cross sectional 0,080 m²

3.180 kg + 135 kg/m
7.800 lbs 980 lbs/ft

Cutting Equipment: Pull Force



Analysis

Drum size

- ◆ **Increase in Diameter**
 - ◆ Largest influence for increasing coke production
 - ◆ Investigation to drum size D (XXL) = 10,36 m (34 ft)
- ◆ **Increase in height FF**
 - ◆ Often limitation of the structure itself
 - ◆ Investigation of FF (XXL) = 45,5 m (150 ft)

Jet Pump selection

- ◆ **Flow and Pressure**
- ◆ **Flow. Increase is possible and required for a stable jet**
 - ◆ Investigation for Q max = 340 m³/h, (1500 gpm)
- ◆ **Pressure**
 - ◆ Max pressure has been set for flange rating ANSI B16.5, 2500 lbs
 - ◆ Max. cutting pressure P max = 350 bar (5.075 psi)

Cutting Equipment

- ◆ **Crosshead, rail type**
 - ◆ Rail type CH with FFA has been considered for further calculation
 - ◆ FFA system must be capable for equipment weight as calculated

Analysis

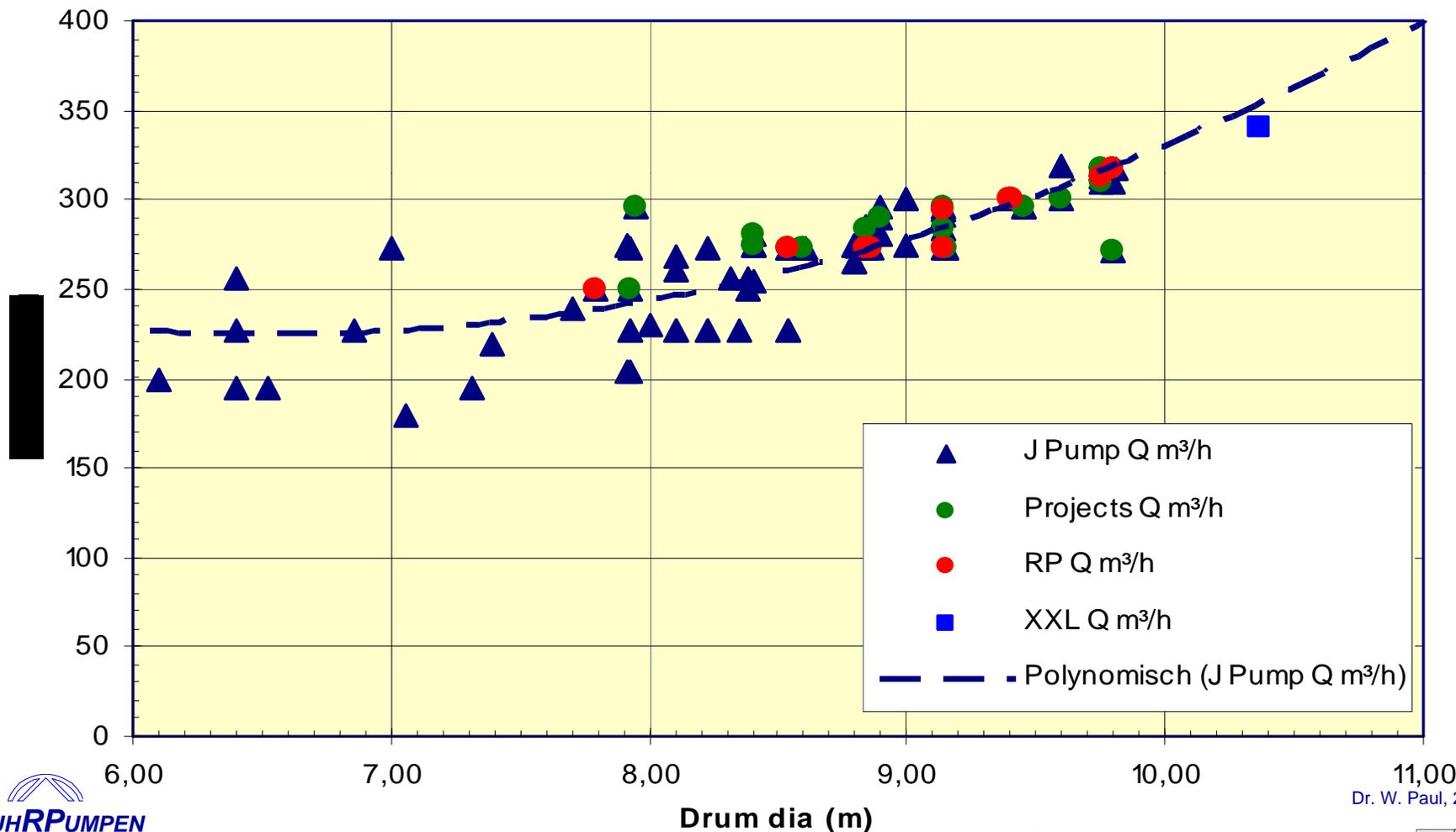
Past

- ◆ Selection of Jet Pump Pressure and Flow by Drum Diameter
- ◆ Selection of Cutting equipment
Pull Force and pull speed was constant over years constant

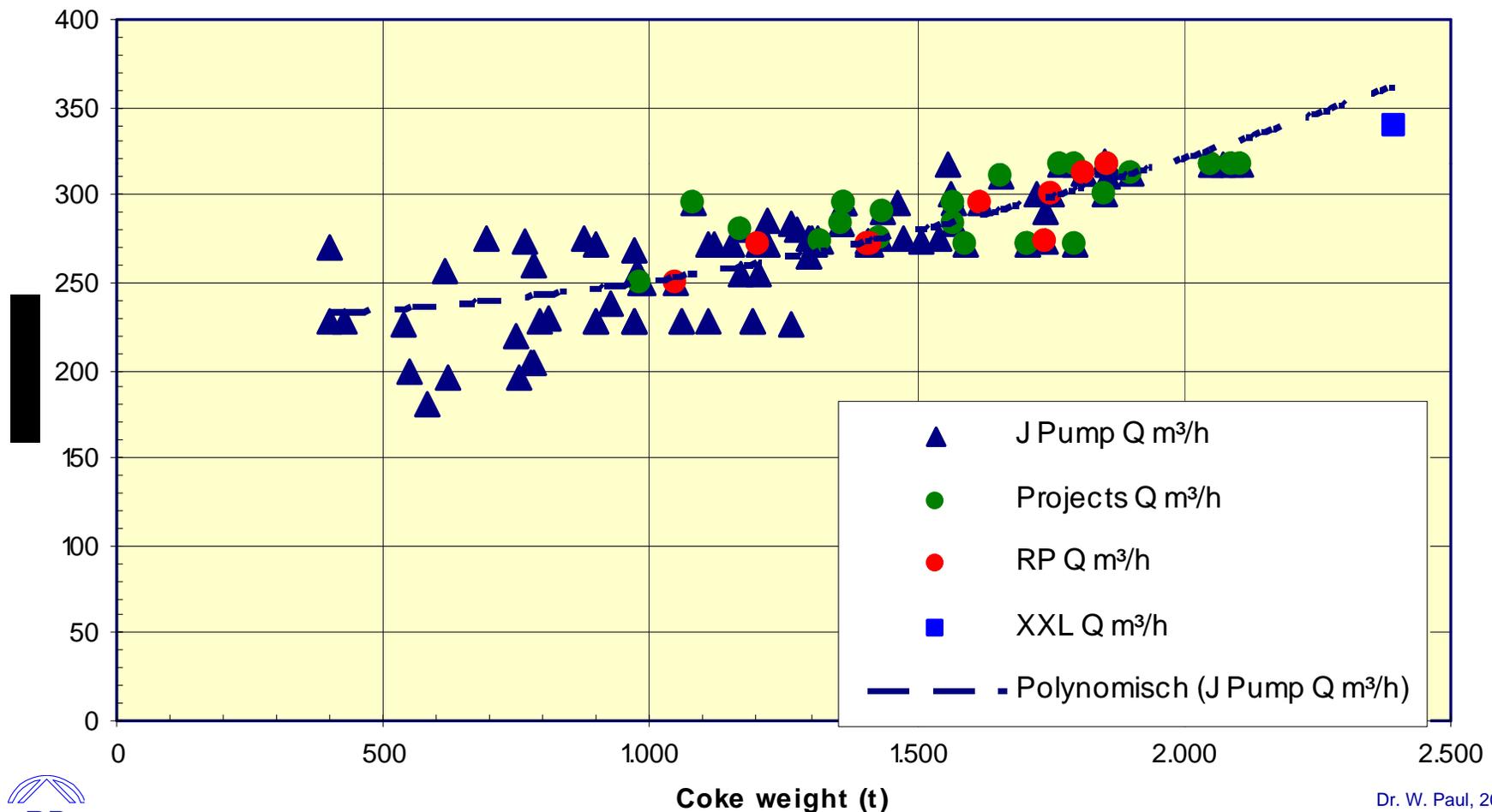
Actual and future

- ◆ Selection of Jet Pump Pressure and Flow by coke production per drum
full scale Tool / nozzle tests
- ◆ Selection of Cutting equipment
(Hoist, Drill Stem, CH + FFA) by drum height FF,
secondary by D drum

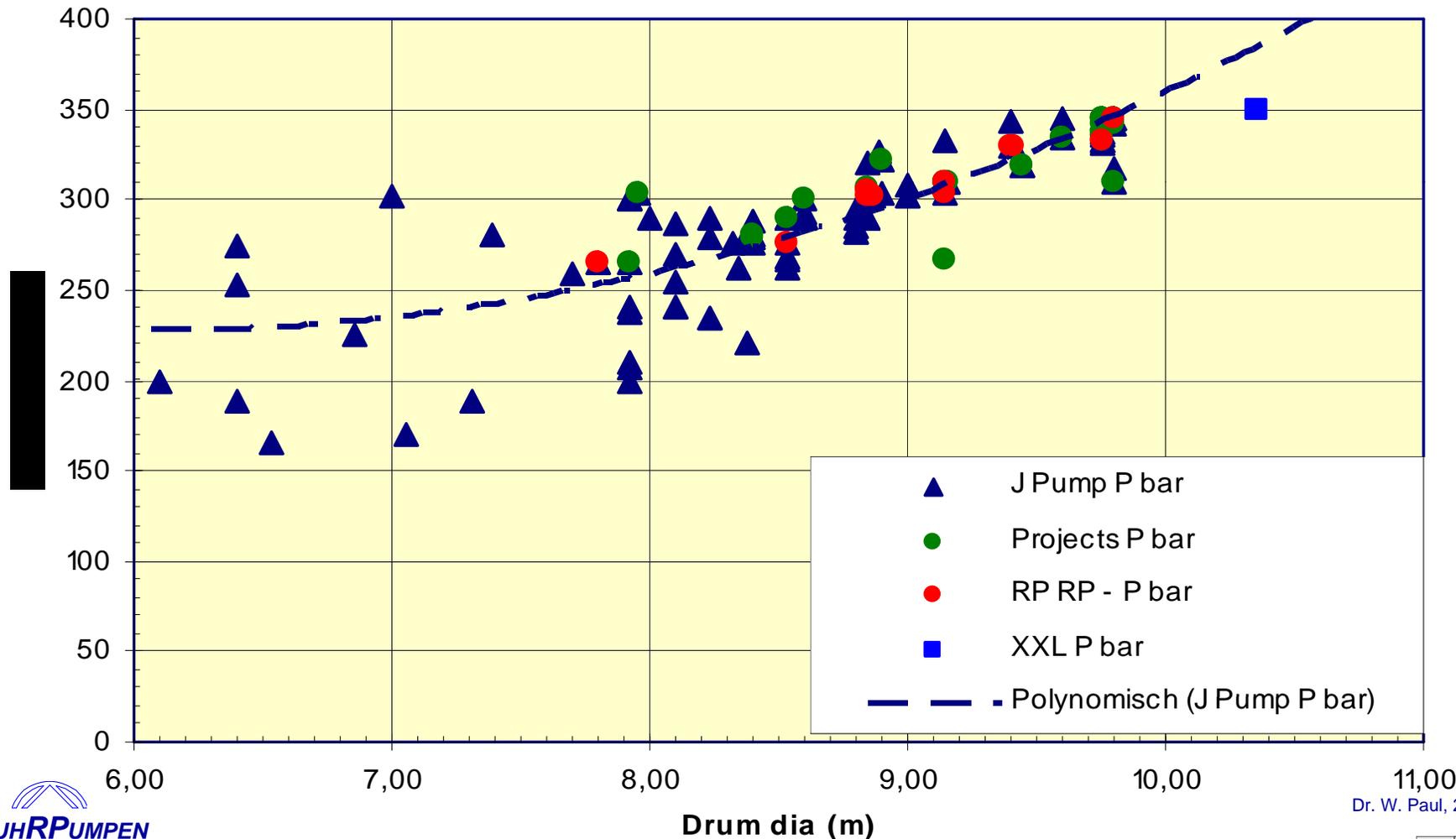
Jet Pump: Flow vs Diameter of drum



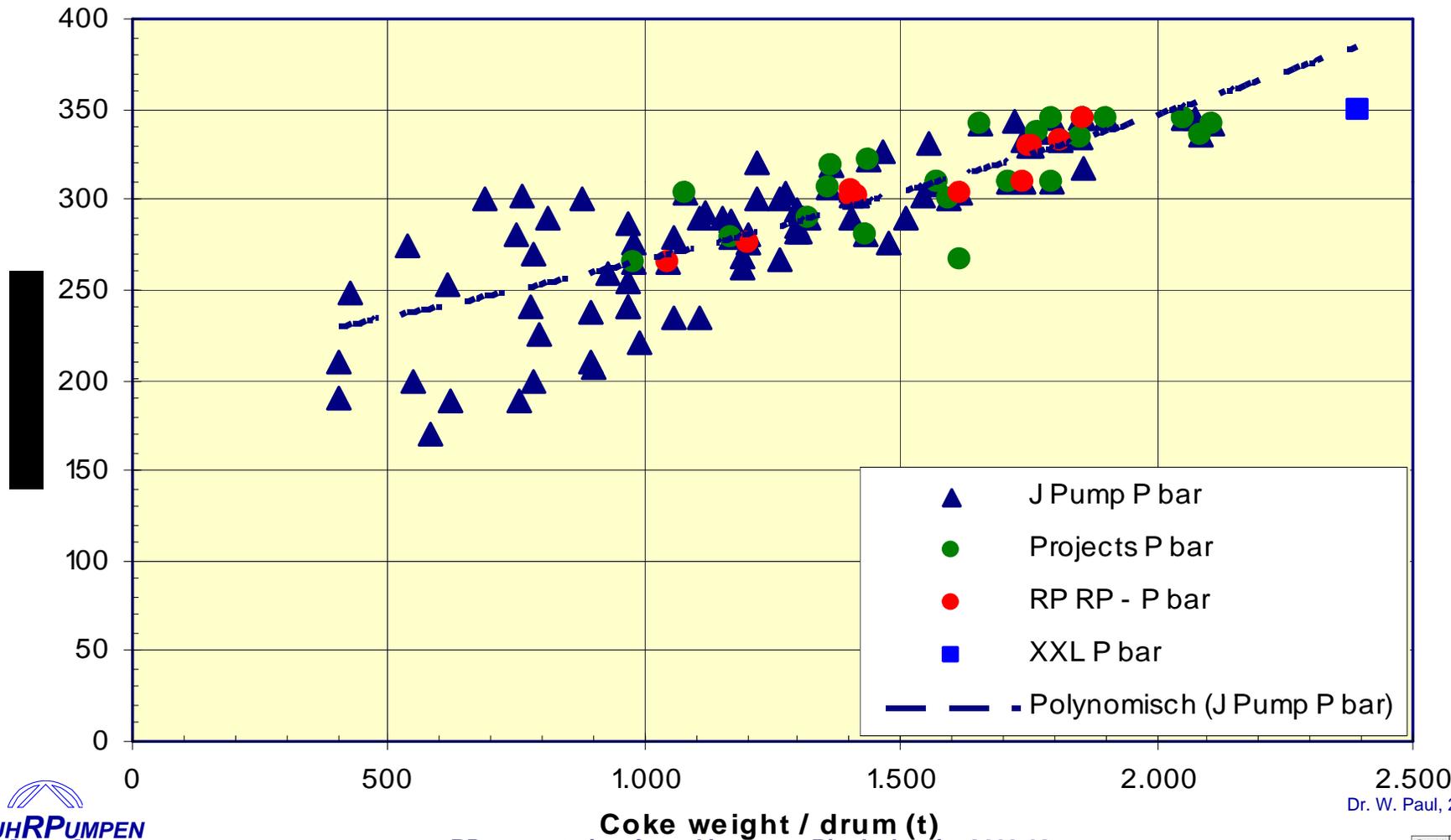
Jet Pump: F_{low} vs Coke weight / drum



Jet Pump: Pressure vs Diameter of drum

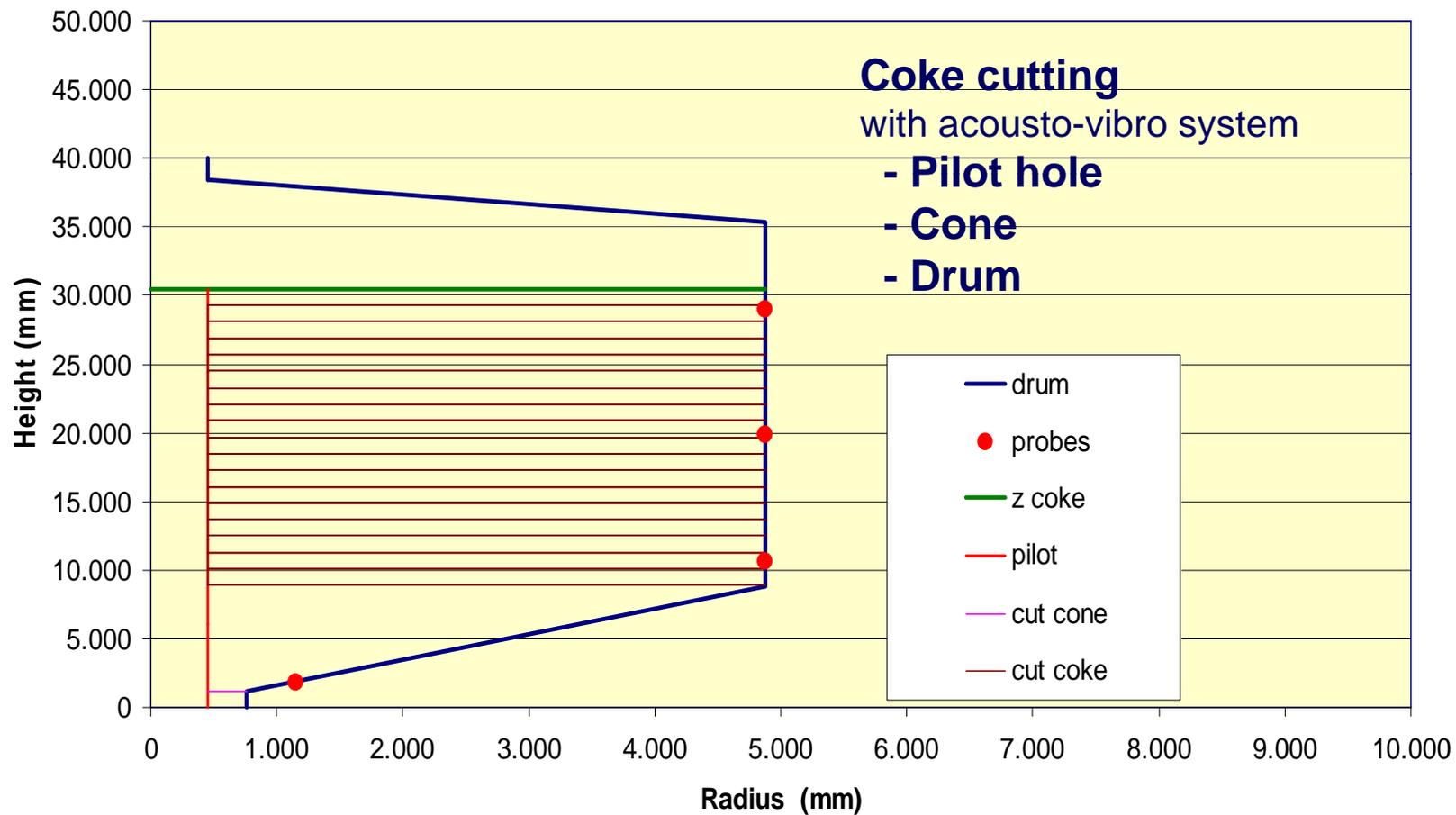


Jet Pump: Pressure vs Coke weight / drum



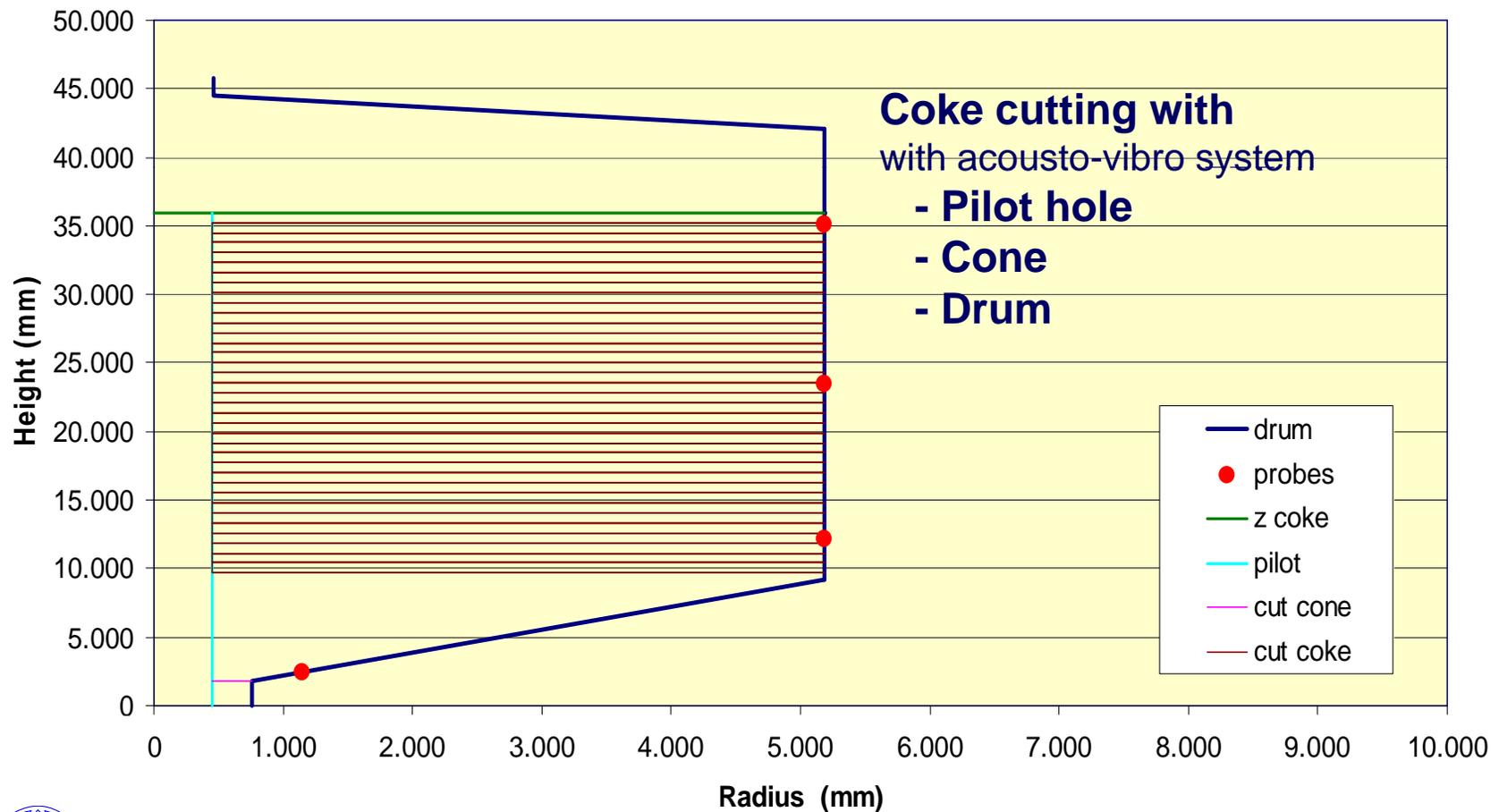
Cutting procedure 32 x 130

Drum, 9,75 x 40,0 (32 ft x 130 ft)



Cutting procedure 34 x 150

Drum D = 10,36 m x 45,7 m FF, (D = 34 ft x 150 ft FF)



Verification

Cutting System

- ◆ High Performance Jet Pump
 - ◆ Flow 340 m³/h
 - ◆ Pressure 350 bar

- ◆ High Performance Cutting Equipment
 - ◆ Hoist Pull Force $F > 40 \text{ kN (8 800 lbsf)}$ at all layers
 - ◆ Hoist Pull Speed $v = 40 \text{ m / min (130 ft/min)}$

- ◆ High Performance Cutting Tool
 - ◆ Hydrodynamic Tool and Nozzle optimization
 - ◆ CFD calculation and full scale testing

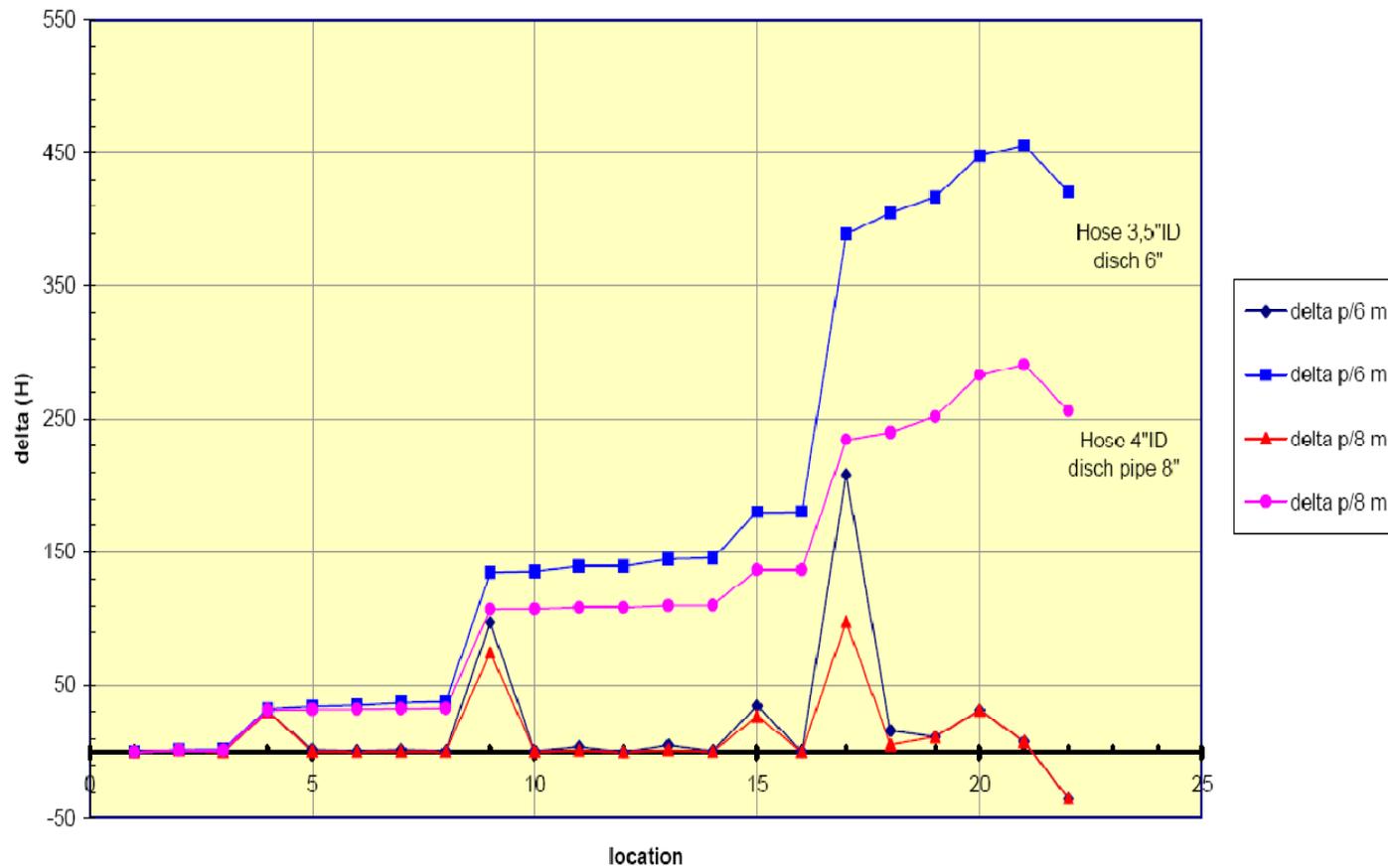
- ◆ High Performance Control System
 - ◆ Measurement and Control of all parameters
 - ◆ Visualization, data logging and analysis

Verification by calculation

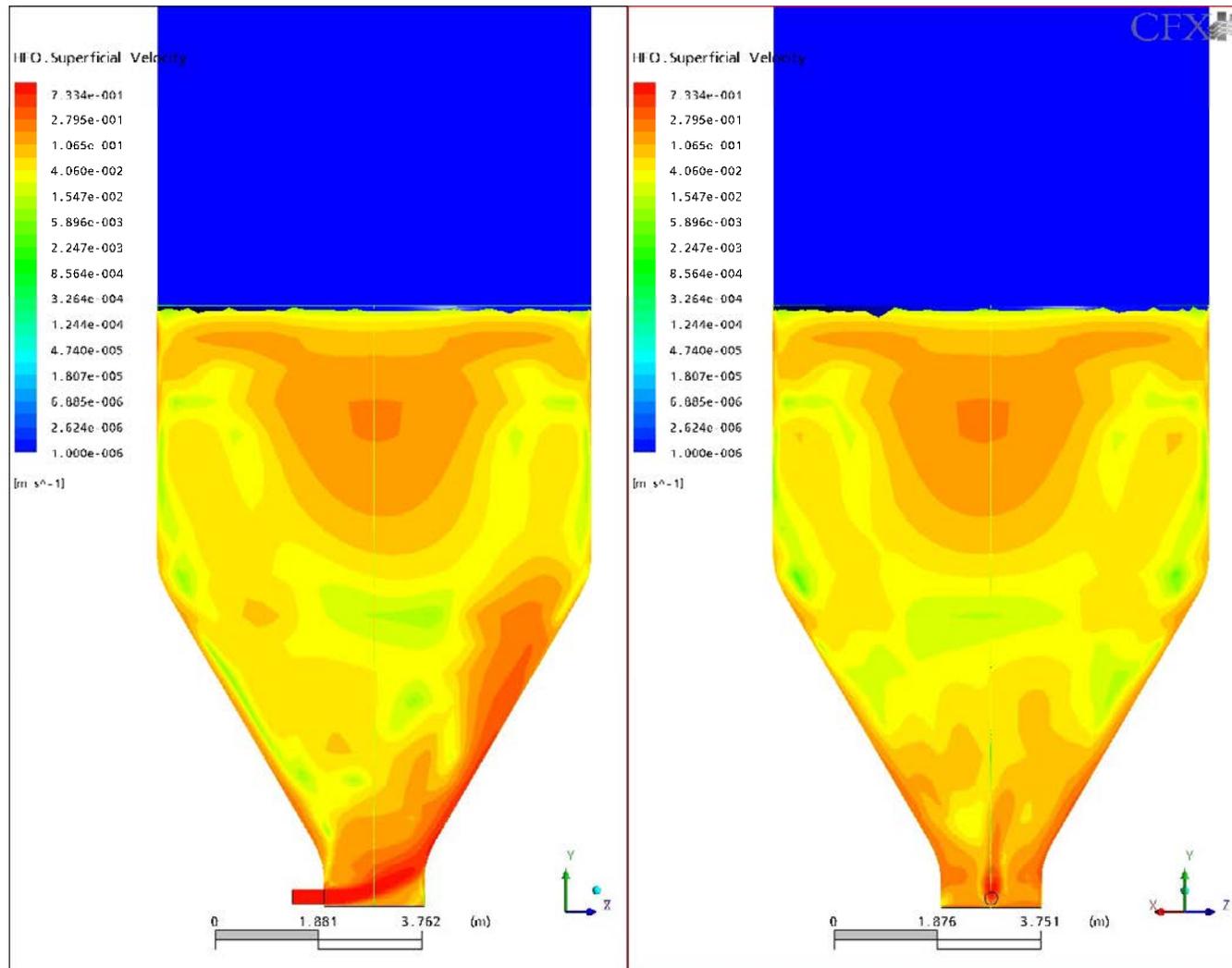
Decoking system,
Discharge line, pressure loss

Calculation

◆ pressure drop



Verification by calculation



Calculation

- ◆ Coke condition

Verification at test bed conditions

Hydraulic Decoking System

- ◆ Performance test of Jet Pump
 - ◆ Full speed performance test, (full flow and pressure)
 - + Lube oil system
 - + Decoking valve
 - + Auto switch Tool

- ◆ Performance test of hoist
 - ◆ Hoist max Pull Force
 - ◆ Hoist reduced Pull Speed

- ◆ Performance test of Crosshead with Free Fall Arrestor
 - ◆ Functional test at RP test bed
 - ◆ Full load test at site

Verification at test bed conditions

Auto switch Drilling and Cutting Tool

- ◆ **Switch tests**
 - ◆ > 200 cycle for every tool at test bed I
 - ◆ Reduced flow and pressure

 - ◆ > 10 cycle for Tool with Jet Pump at test bed II
 - ◆ Test of switch device full flow and pressure
 - ◆ Test of nozzles full flow and pressure
 - ◆ Test of nozzles full distance R up to 6,0 m

- ◆ **Nozzle optimization**
 - ◆ Nozzle test reduced flow and pressure
 - ◆ Nozzle test full flow and pressure

Tool: full performance test bed



Tool

full performance
test bed for
Autoswitch Tool

Test distance

R = 6,00 m (20ft)
Flow up to 400 m³/h
1760 gpm
Pres up to 350 bar
5075 psi



Dr. W. Paul, 2009-05

Conclusion

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- ◆ Is able to provide high performance

Hydraulic Decoking System for Drum size up

Diameter	D = 10,36 m, (34 ft)
Height FF	FF = 45,70 m, (150 ft)

**System can be fully performance tested
with testing of each individual functional group
at full working condition**

End

THANKS FOR YOUR
ATTENTION

