

Coperion – The Full Service Partner

COMPOUNDING
SYSTEMS.



BULK MATERIALS PLANTS
AND COMPONENTS.



GLOBAL SERVICE.



Coperion – Confidence Through Partnership.

● The Company

- ❑ Powerful partner with long-standing tradition for innovative products

● Products and Services

- ❑ Integrated approach to provide creative solutions

● New Improvements in Extrusion

- ❑ Geometry
- ❑ Power
- ❑ Materials
- ❑ Controls

Sales and Service:



Sales, Production/Engineering, Service:



< 50 Employees



< 100 Employees



> 100 Employees

Representatives:



Coperion – 240 Years of Combined Experience

2001 – Merger to Form the Coperion Group



Founded 1993



Founded 1900



Founded 1879

Global Presence:

Compounding systems installed

Bulk materials plants installed

Employees

Customer Service engineers and technicians

approximately 7,000

more than 6,000

more than 2,000

more than 120

Coperion Corporation: Complete Solutions Provider

Complete Turnkey
Systems

Process Engineering

Design Engineering

Manufacturing

Field Service

Replacement
Parts

Refurbishing &
Upgrades

Process Laboratory

COPERION

RAMSEY, NJ

Coperion Corporation - Ramsey, New Jersey



COPERION
RAMSEY, NJ

Coperion Corporation - Wytheville, Virginia



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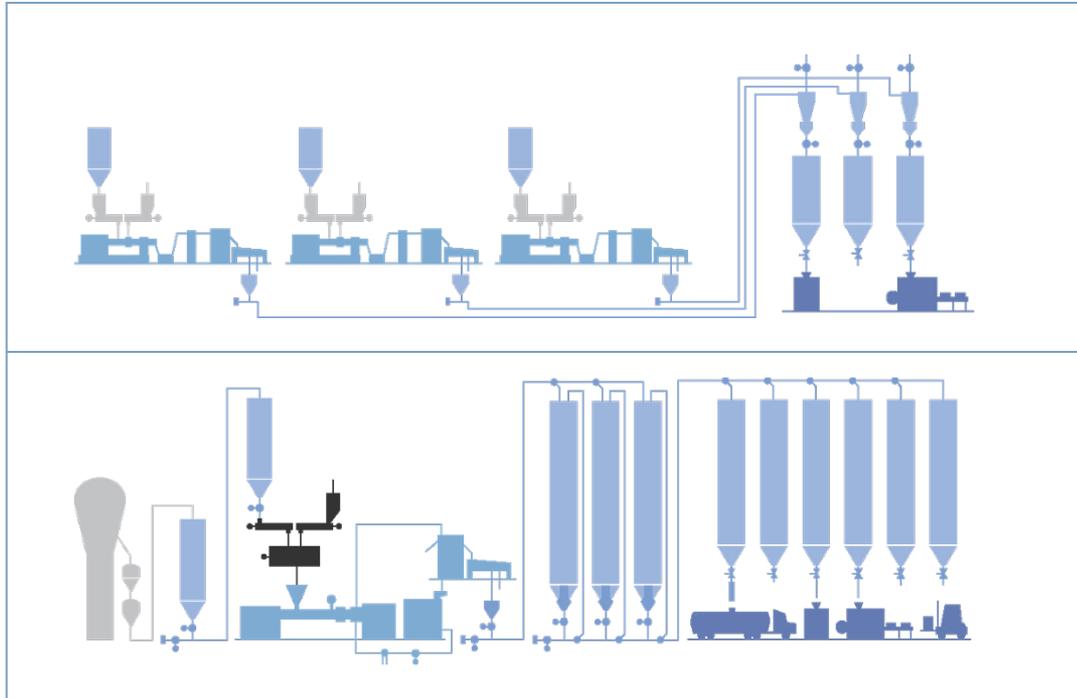


Representatives

Coperion Range of Products and Services

● Products

- ❑ Compounding Systems, Bulk Materials Plants and Components



Global presence in the plastics, chemical and food processing industries.

● Services

- ❑ Global Technical Solutions and After Market Sales Support

Coperion Businesses



**Compounding Systems
Polyolefins**

**Engineering Plastics and
Masterbatch**

**Special Applications and
Engineered Process Systems**



**Bulk Materials Plants
and Components**



Global Service

Polyolefins

Engineering Plastics,
Masterbatch, Long-fiber technology

PVC, Heat and shear sensitive plastics,
Powder coating, Toner, General
chemicals, Food, Full Turnkey Systems,
System upgrades and Modular systems

Polyolefins, Engineering Plastics,
Preliminary Products, General
chemicals, Food, Minerals

Coordinated Global Technical
Solutions and After Market Sales
Support across the entire range of
products and the process chain

Coperion Compounding Systems

Experience and Statistics

Compounding Systems Worldwide

● Polyolefins	760
● Engineering plastics	2,300
● Masterbatch	565
● Long-fiber reinforced plastics	25
● Heat and Sheat Sensitive Material PVC, Cable, TPE	1,035
● Powder coatings, Toner	525
● Direct Extrusion / Calander	290
● Chemical reaction technology	510
● Food processing	250
● Others	635
● Total	6,890

More than 25% of all installed compounding systems worldwide were supplied by Coperion

ZSK 101

Coperion Compounding Systems Training

From Plastics to Cereal and Everything in Between



www.zsk101.com

Coperion Compounding Systems

Advantages of the ZSK Series

- **Co-rotating twin screw:**
closely intermeshing and self-wiping
- **Reduced cost due to wear:**
modular system design
- **Greater flexibility:**
speed (1200 / 1800 rpm),
residence time and
throughput
- **Two design series:**
ZSK MEGAc ompounder for the highest
torques
ZSK MEGAvolume for the highest
volume requirements

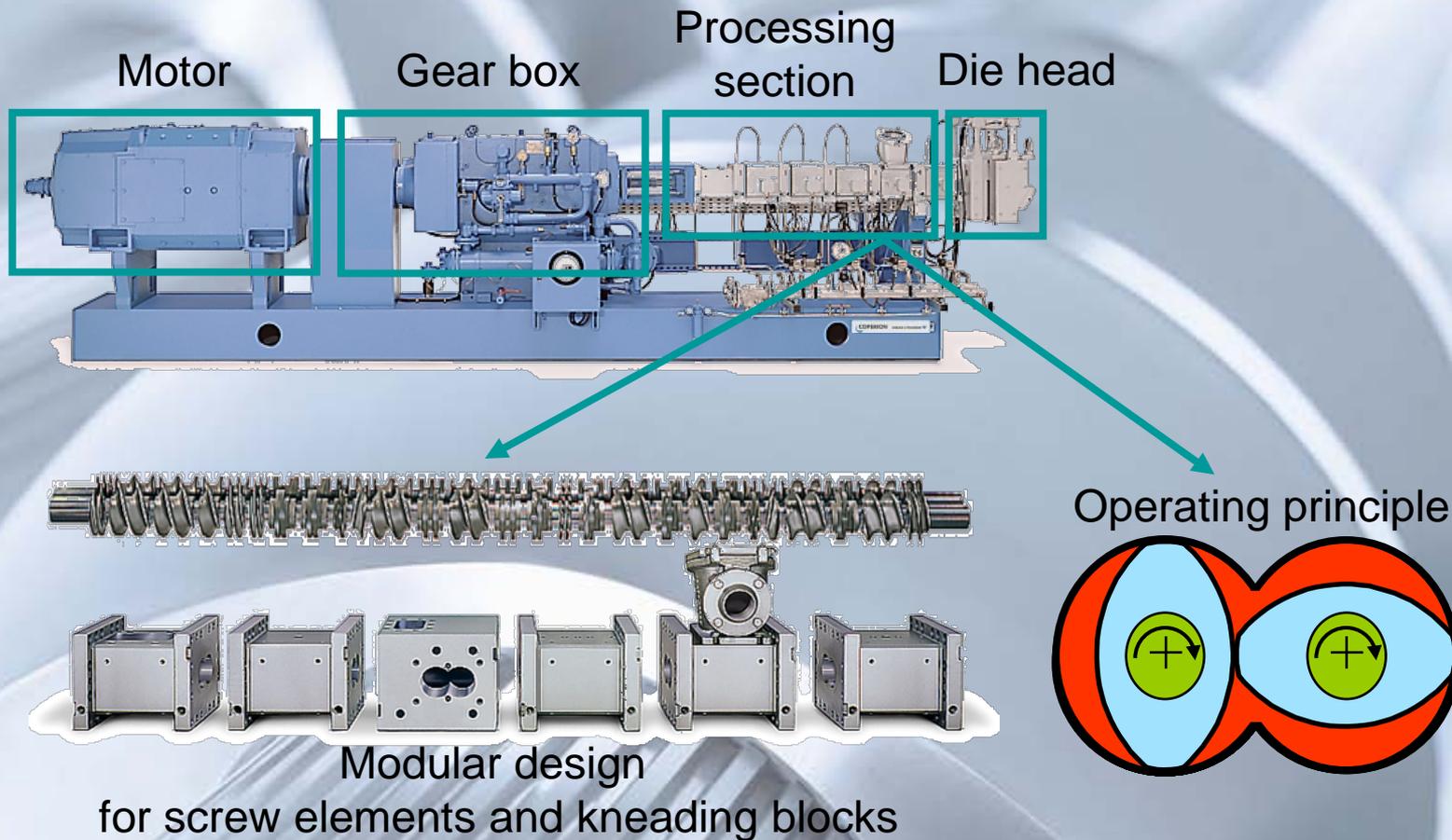


Coperion Compounding Systems

Advantages of the ZSK Series

Basic layout and main components of the ZSK MEGAcocompounder

With drive powers from 10 kW up to 12 MW for rates between 5 kg/h and 75 t/h



Coperion Compounding Systems

Advantages of the ZSK Series

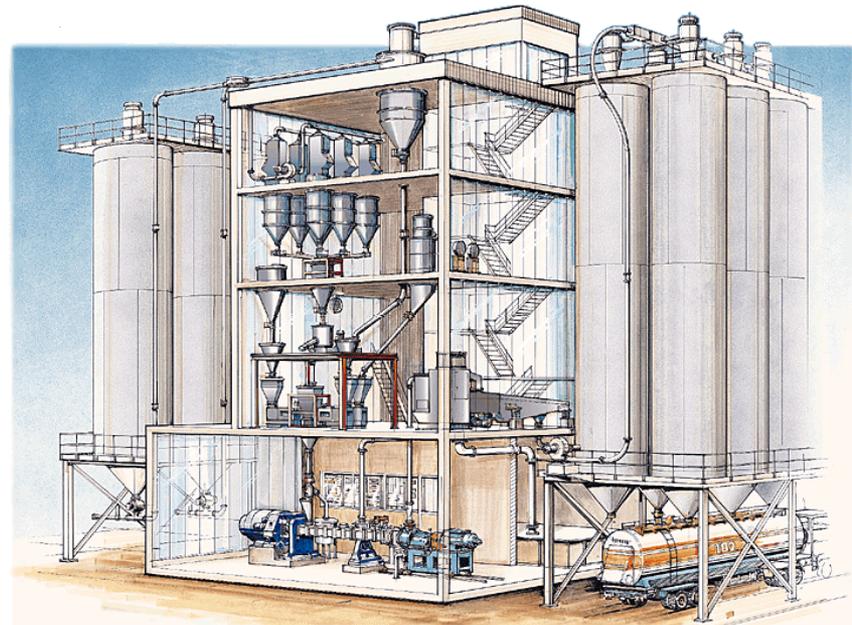
ZSK series with screw diameters from 25 to 380 mm



Coperion Turnkey Technology

Capabilities of Coperion Engineered Systems Group

- Thirty Five years experience
- Over 220 installations
- Upgrade existing lines
- New lines in existing facilities
- Complete new facilities
- Modular Systems
- Single Source Responsibility
- Firm Price Contract



Coperion – The Full Service Partner

Complete Compounding Plant Design and Installation

Additional handling, weighing, blending

Powder handling, storage, blending, and conveying

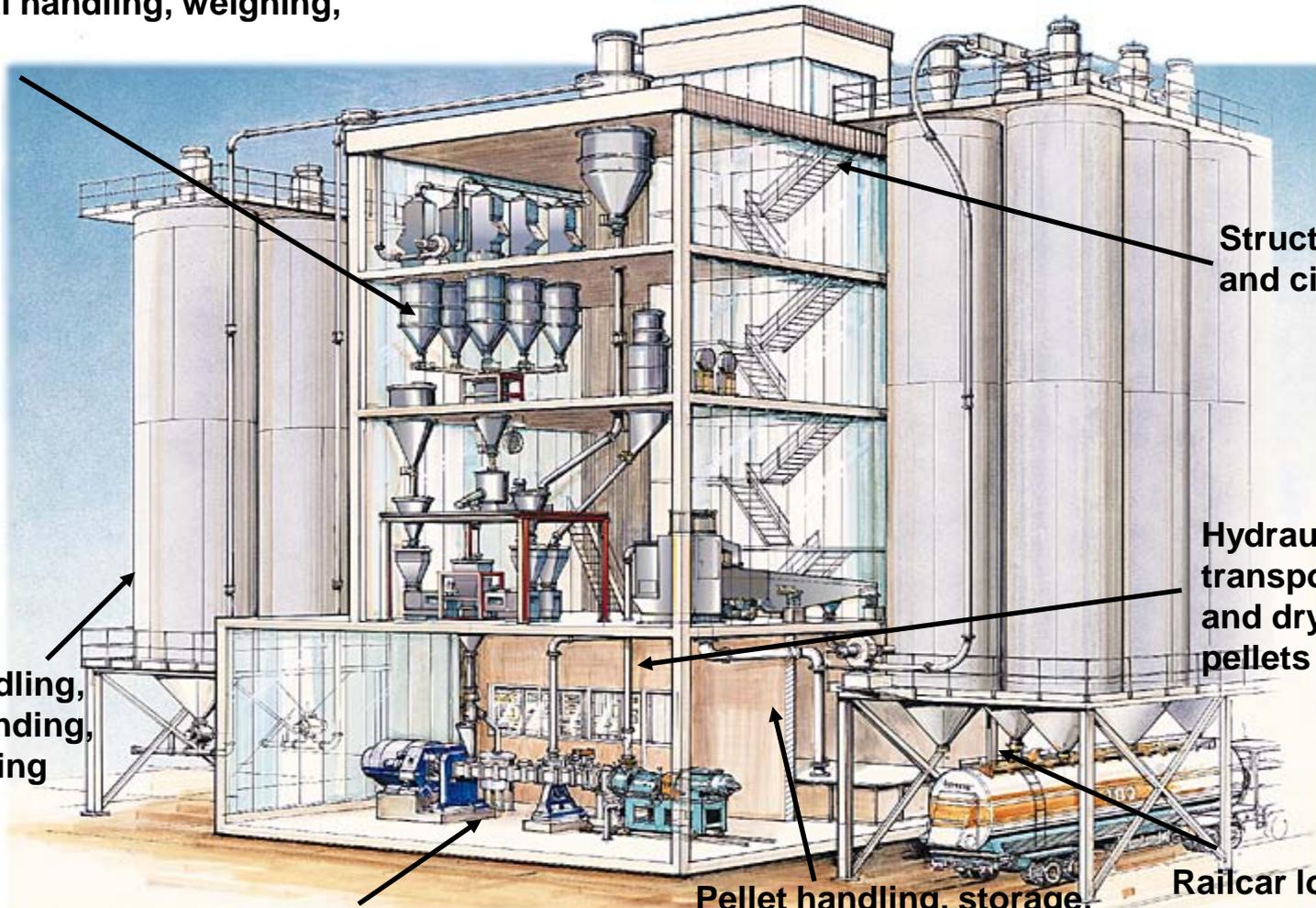
Extrusion & pelletizing

Pellet handling, storage, blending, conveying

Railcar loading and bagging packing

Structural steel and civil work

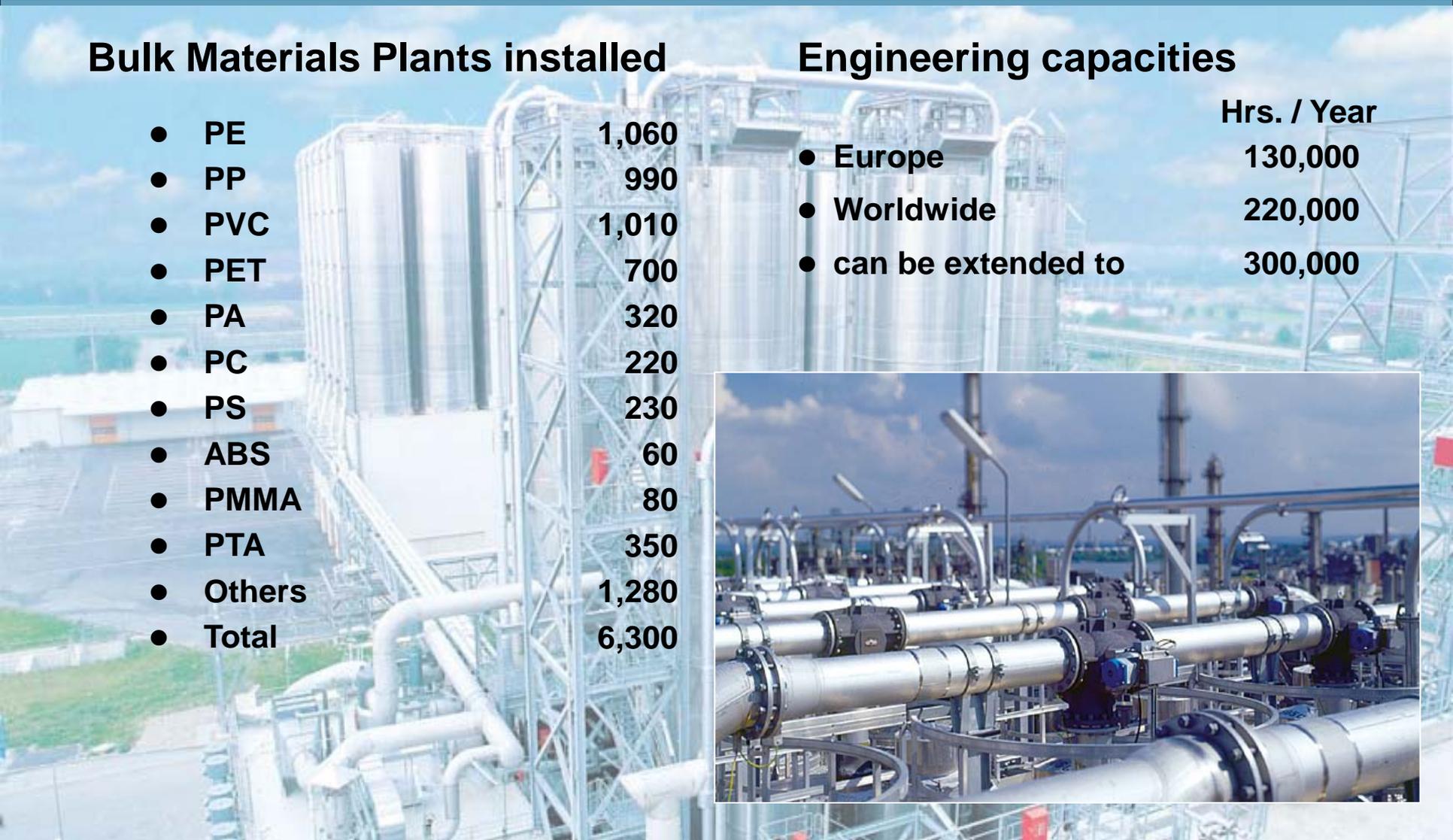
Hydraulic transport Conticon and drying of pellets



Coperion Bulk Materials Plants and Components

Experience and Statistics

Bulk Materials Plants installed



● PE	1,060
● PP	990
● PVC	1,010
● PET	700
● PA	320
● PC	220
● PS	230
● ABS	60
● PMMA	80
● PTA	350
● Others	1,280
● Total	6,300

Engineering capacities

	Hrs. / Year
● Europe	130,000
● Worldwide	220,000
● can be extended to	300,000



Coperion Bulk Materials Plants and Components

Experience in Plant Design

Plants for bulk materials handling and logistics

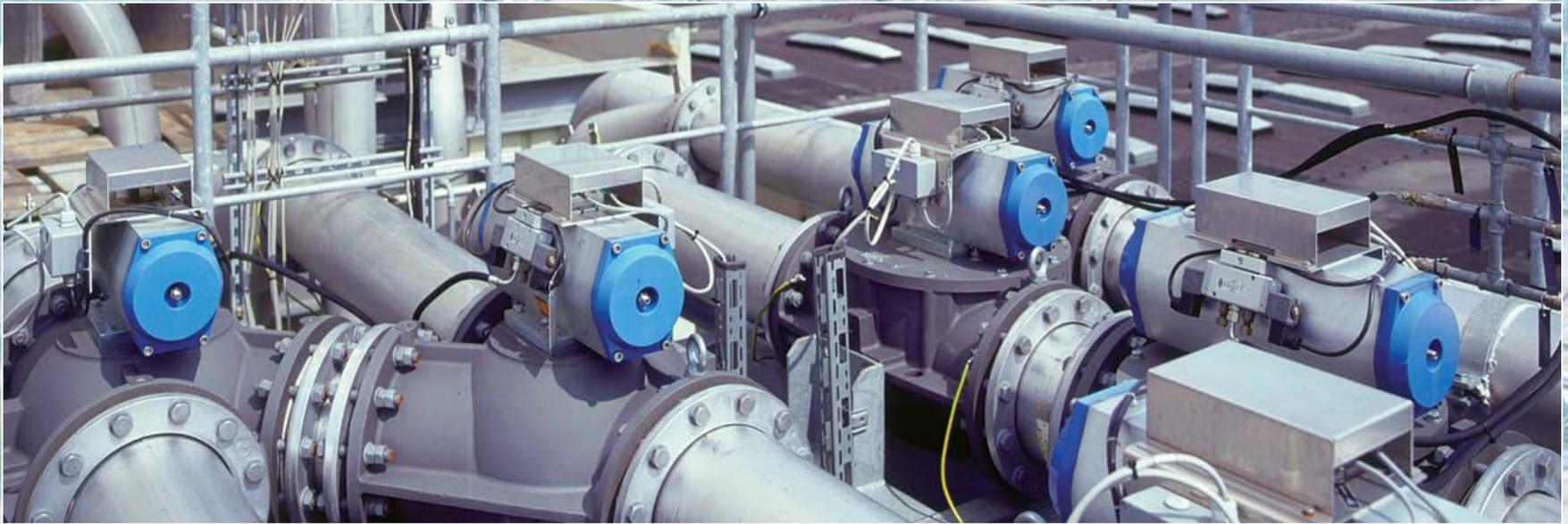
**Project
Management**

**Basic & Detail
Engineering**

**Global
Procurement**

**Delivery &
Supply logistics**

**Installation &
Comissioning**



Coperion Bulk Materials Plants and Components

Know-How in Components

Components for handling of powder and granular bulk materials

Rotary valves

Feeding into pneumatic conveying systems,
discharge from hoppers

Diverter valves

Distribution, convergence of bulk solid flows

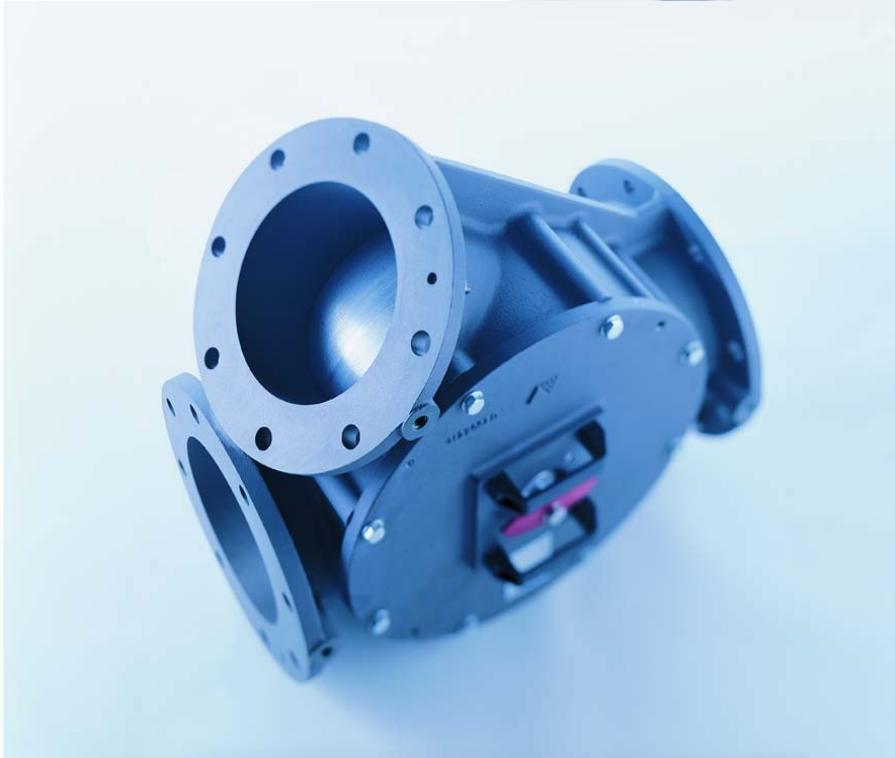
Slide valves

Closing devices



Coperion Bulk Materials Plants and Components

Know-How in Components



Rotary valve



Slide gate

Coperion Global Service

Productivity and Efficiency from the Beginning

Process Technology

- www.zsk101.com
- Process Lab
Most complete facility in NAFTA
- ZSK 101/102
Process training at Coperion or your Site
- De-bottleneck your process
- Develop a new process
- Improve screw design data with EXCO 32

Services

- Plant Upgrades and Modernization
- Extruder Refurbishing
- Gearbox Refurbishing
- Barrel and Parts Refurbishing Service
- Barrel Bore Wear Measurement
- System and Machine Inspection Services
- Field Service and Emergency Repairs
- Local Service Centers

Replacement Parts

- Largest Replacement Parts Stock In The Industry
- 24 Hours Service
- Gear Box Exchange program
- Screw Assembly Change-out Program



Coperion – Confidence Through Partnership.

- **The Company**

- Powerful partner with long-standing tradition for innovative products

- **Range of Products and Services**

- Integrated approach to provide creative solutions

- **New Improvements in Extrusion**

- Geometry
- Power
- Materials
- Controls

Sales and Service:



Sales, Production/Engineering, Service:

■ < 50 Employees

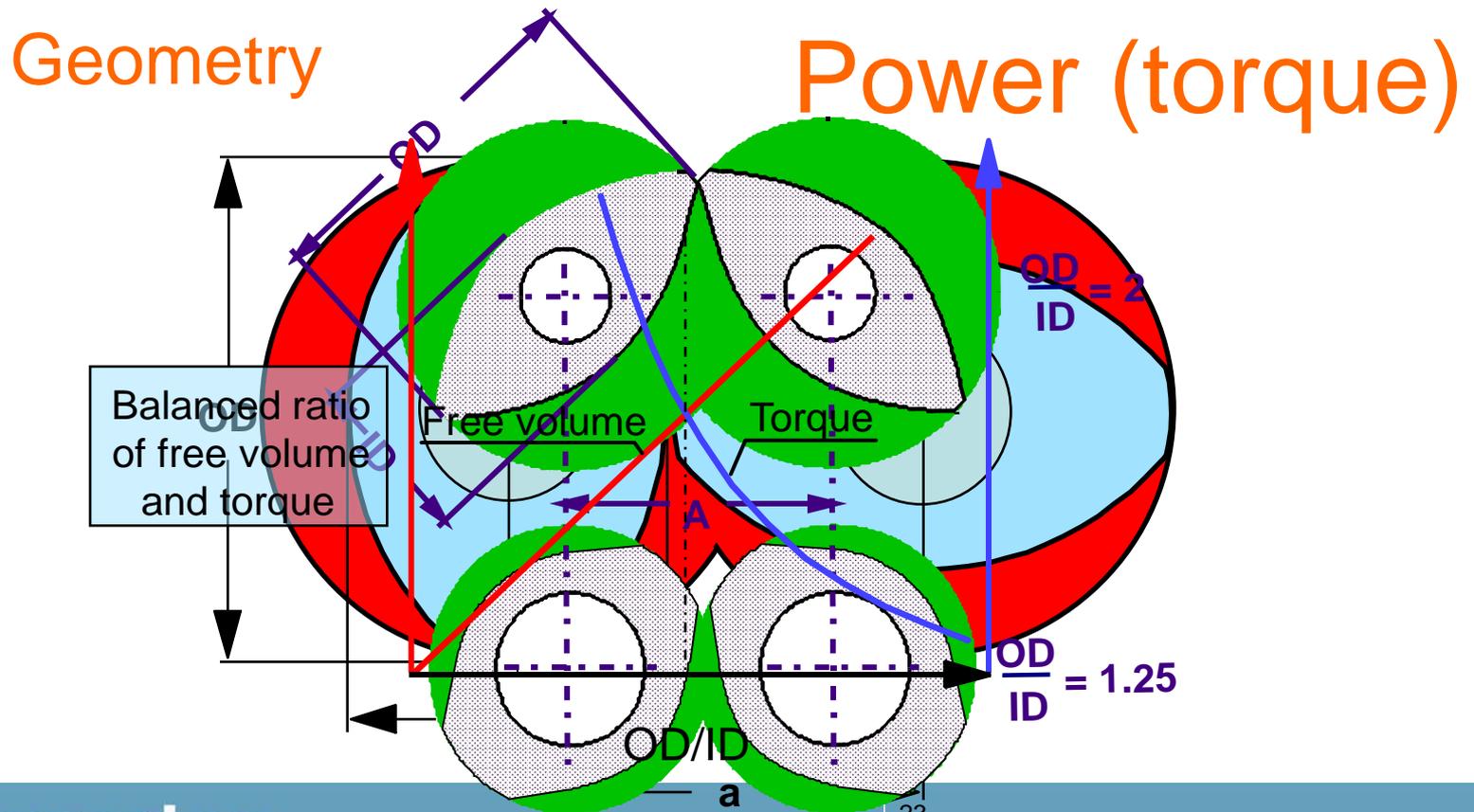
■ < 100 Employees

■ > 100 Employees

Representatives:

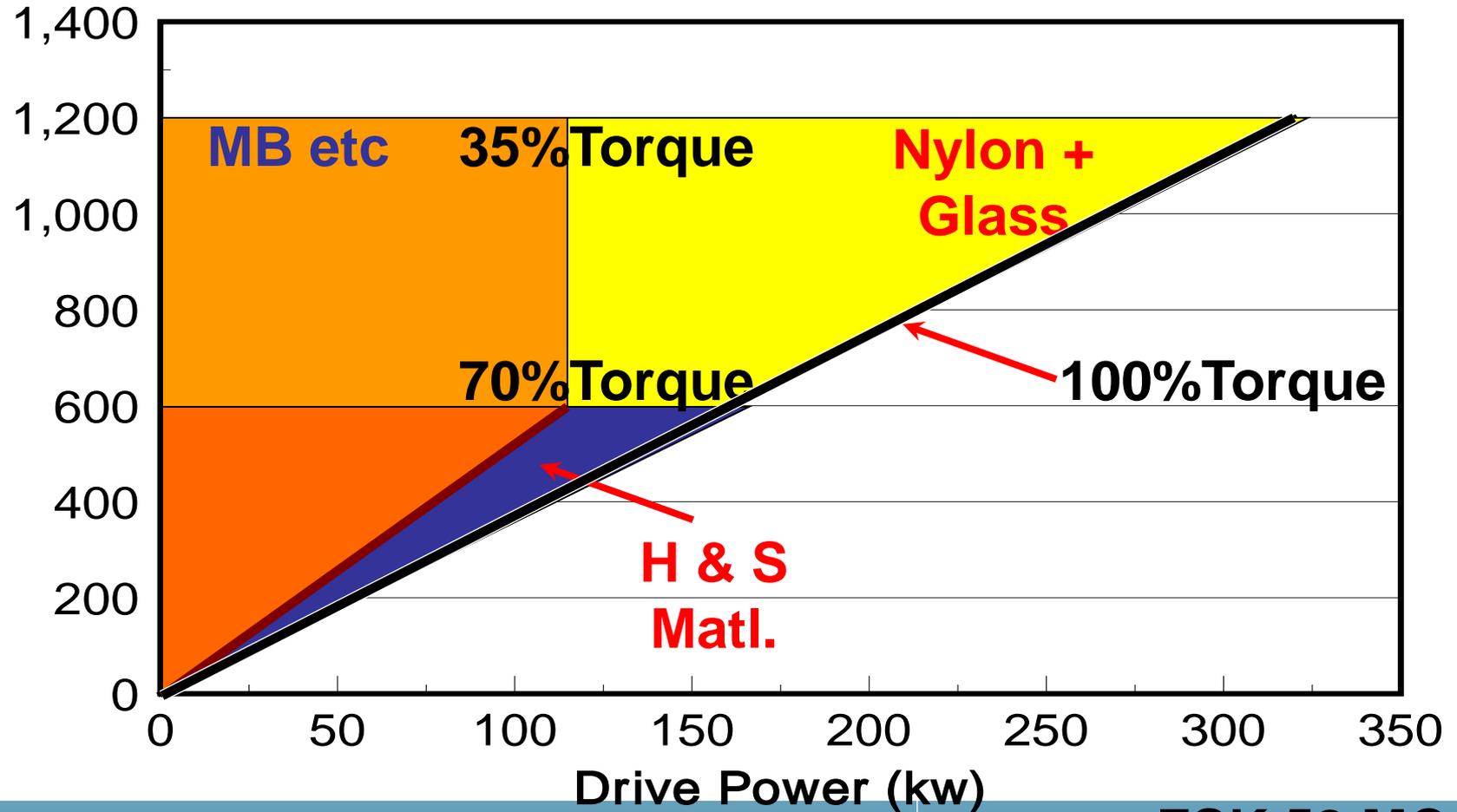


Degrees of Freedom in Twin-Screw Extruder Design



What is % Torque

Speed (RPM)



MEGAvolume with large volume

for products with low bulk density

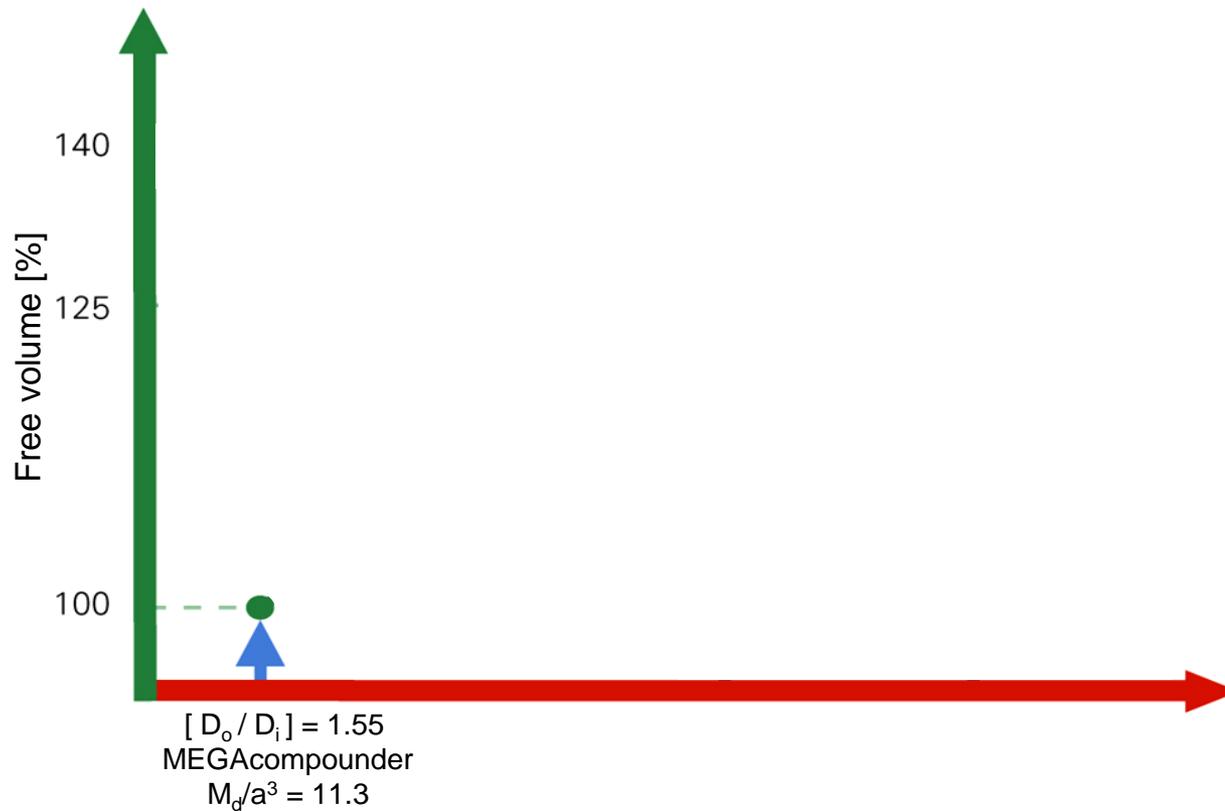
for processes with low

specific energy input (< 0.1 kWh/kg)

ZSK MEGAvolume

Compounding with large screw channel volume

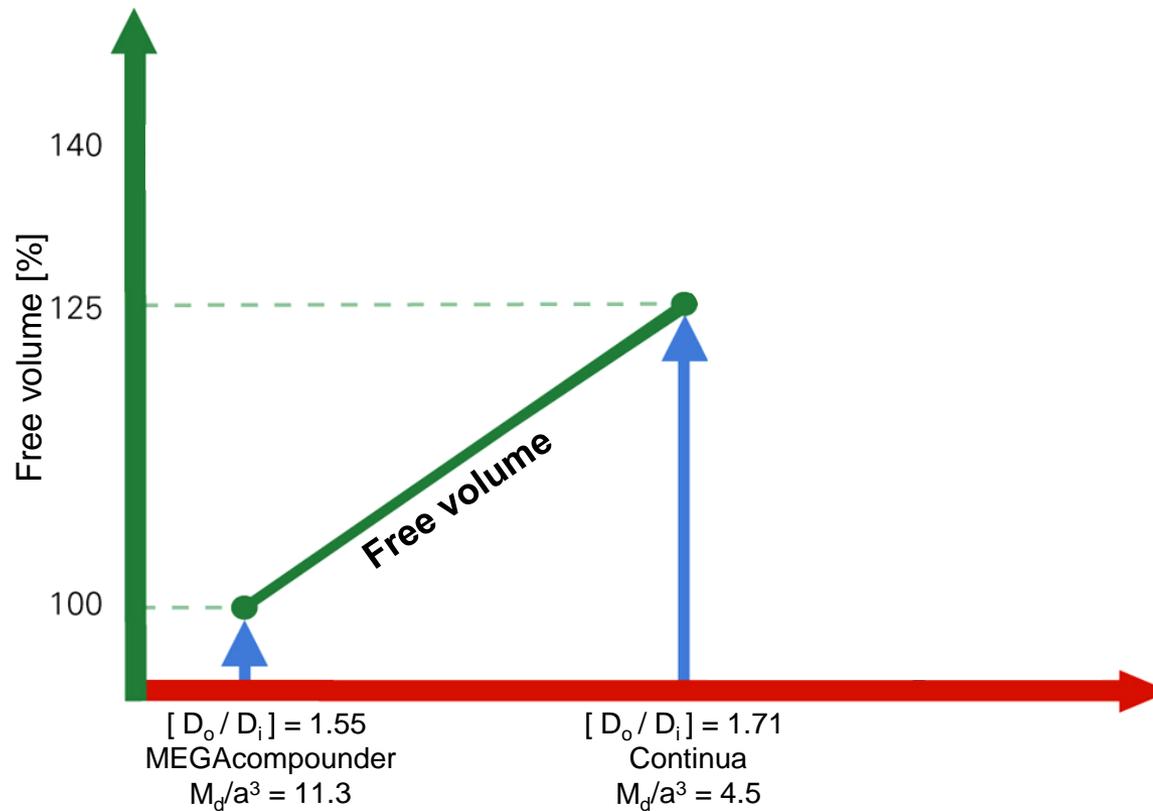
Development of free screw channel volume



ZSK MEGAvolume

Compounding with large screw channel volume

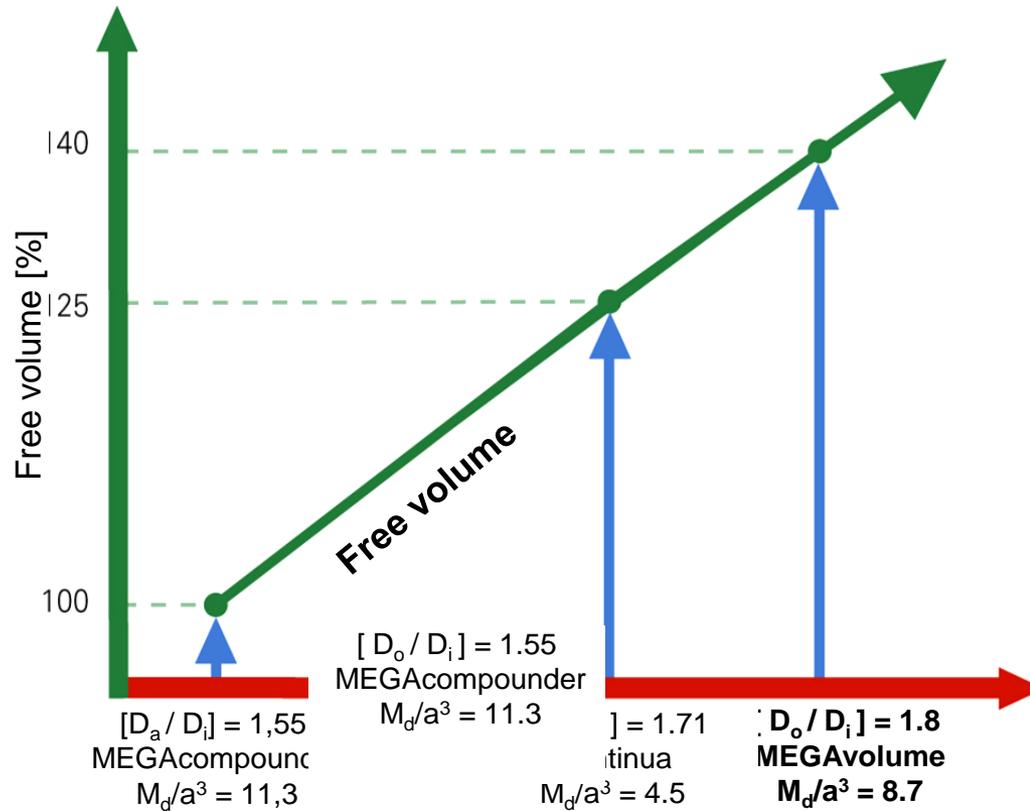
Development of free screw channel volume



ZSK MEGAvolume

Compounding with large screw channel volume

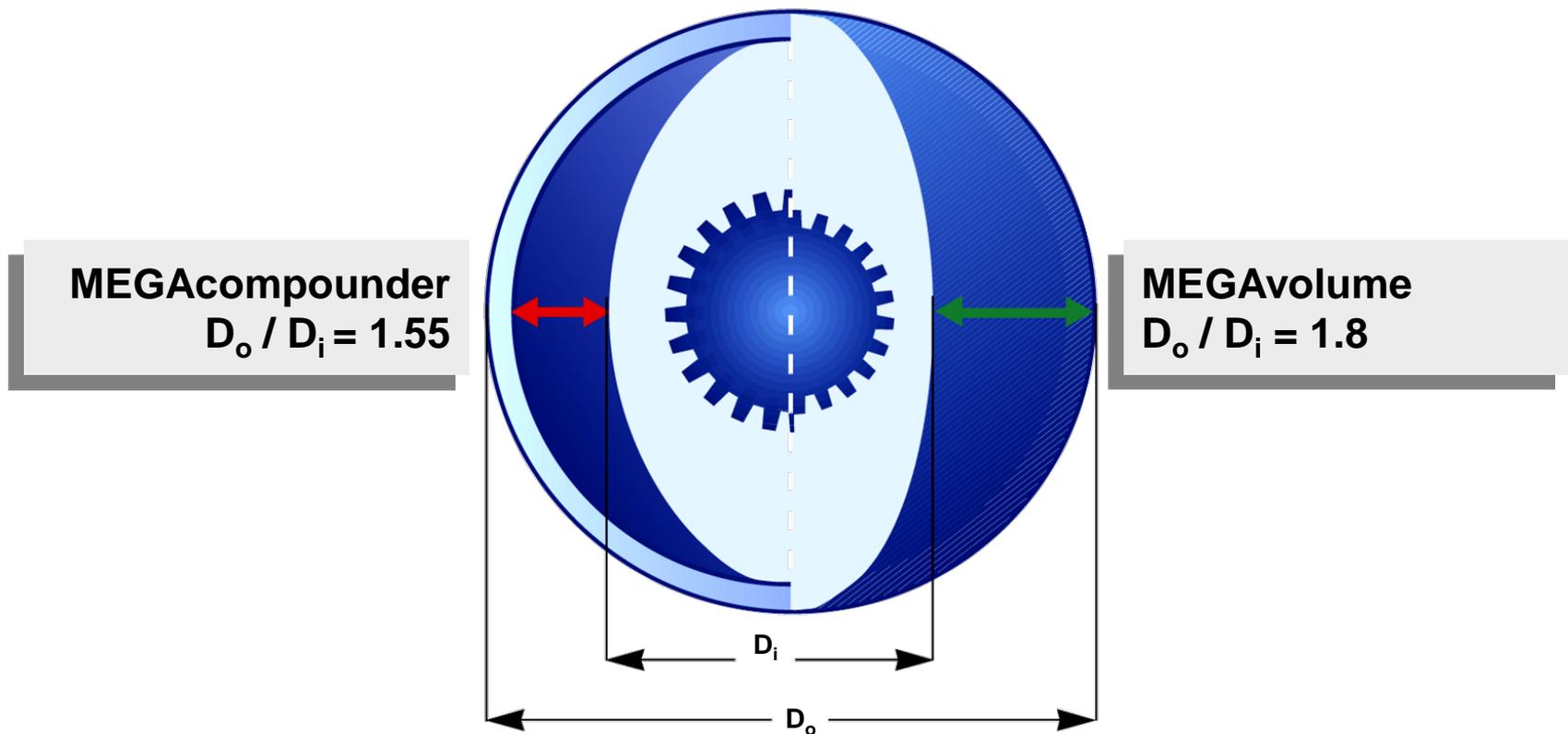
Development of free screw channel volume



ZSK MEGAvolume

Compounding with large screw channel volume

Increased channel volume through larger barrel bore and reduced inner (root) diameter



ZSK Screw and Barrel Materials

The Types of Wear

Mechanical Wear

- **abrasion (product/metal)**
- **erosion (product stream)**
- **adhesive (metal/metal)**
- **surface fatigue (product/metal)**

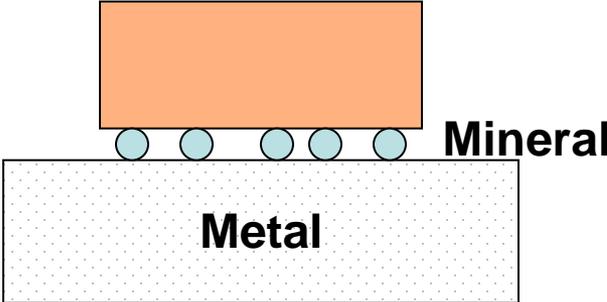
Chemical Wear

- **corrosion (product)**

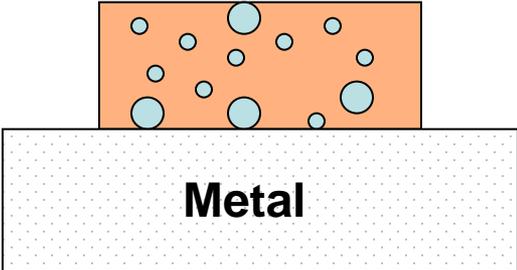
Types of Wear in Plastics Processing

Abrasive

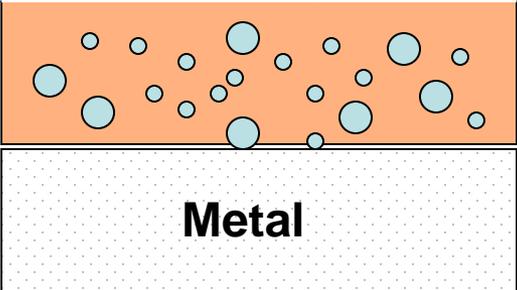
Unmolten Polymer



Unmolten Mineral Filled Polymer

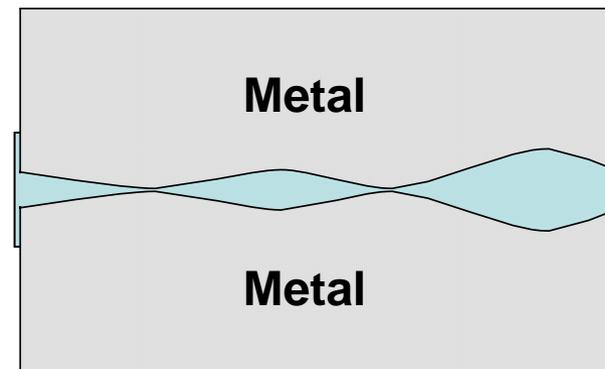
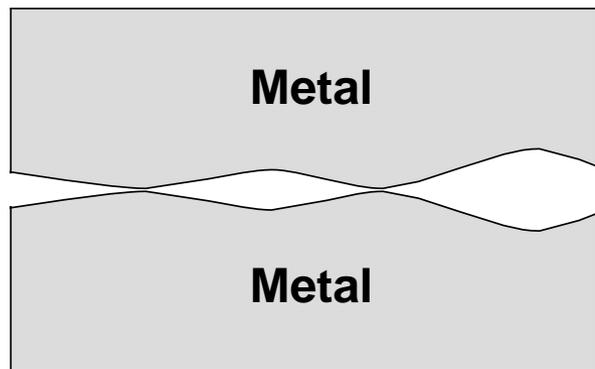


Molten Mineral Filled Polymer

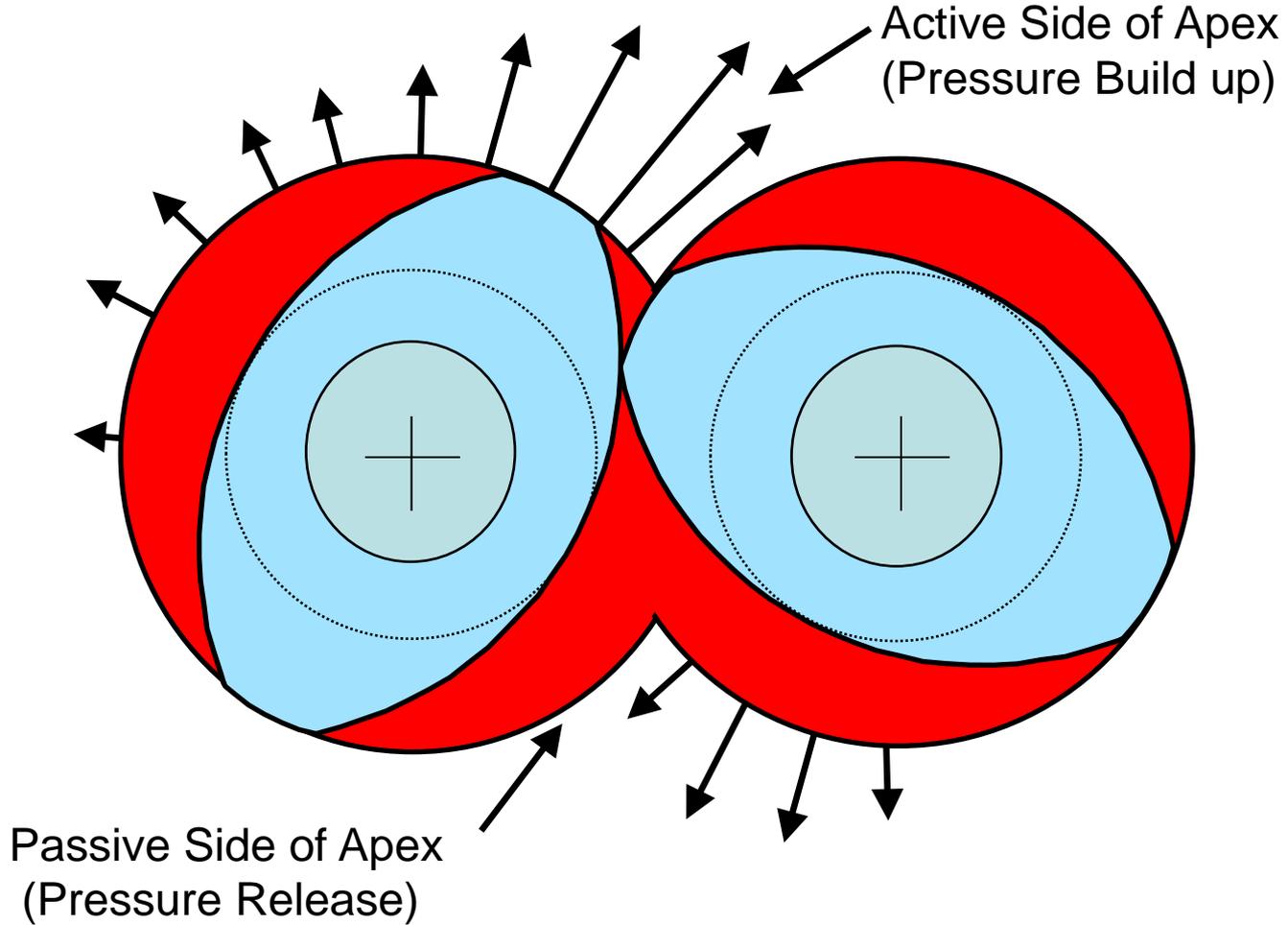


Types of Wear in Plastics Processing

Adhesive



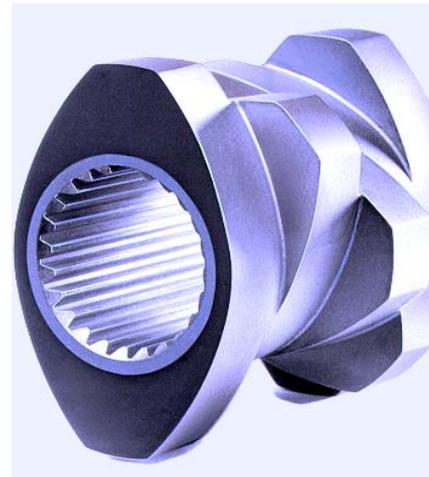
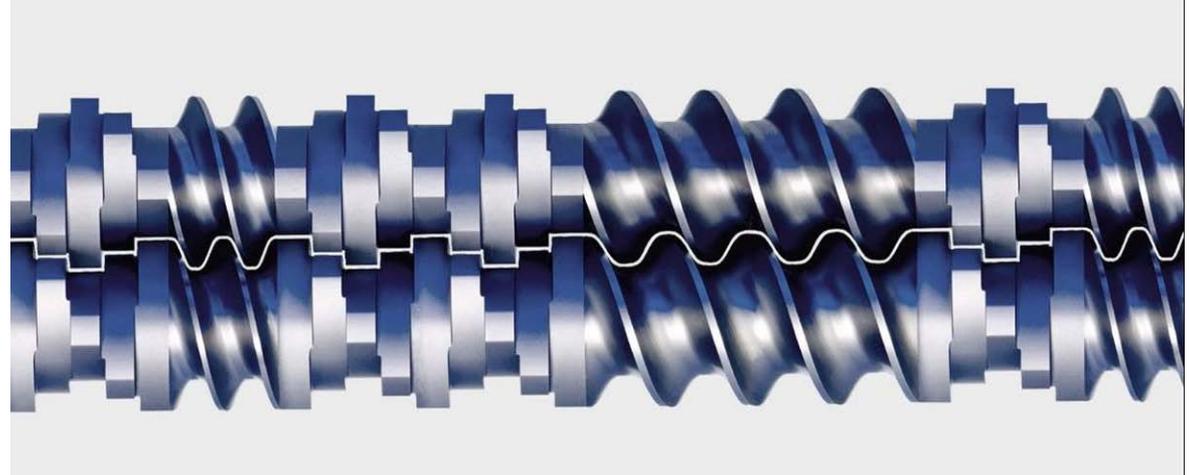
Schematic Representation - Radial Pressure Profile of the ZSK Extruder



ZSK Screw Elements

Materials of Construction

- Nitrided
- Stainless
- Thru Hardened
- Crest Welded
- Powder Metallurgical



ZSK Screw Element Materials

Screw Wear Protection Processes

Process

Application Examples

Nitriding

Nitralloy Steel

Solid thru-hardened

Stainless Steel, Tool Steels

HIP Material

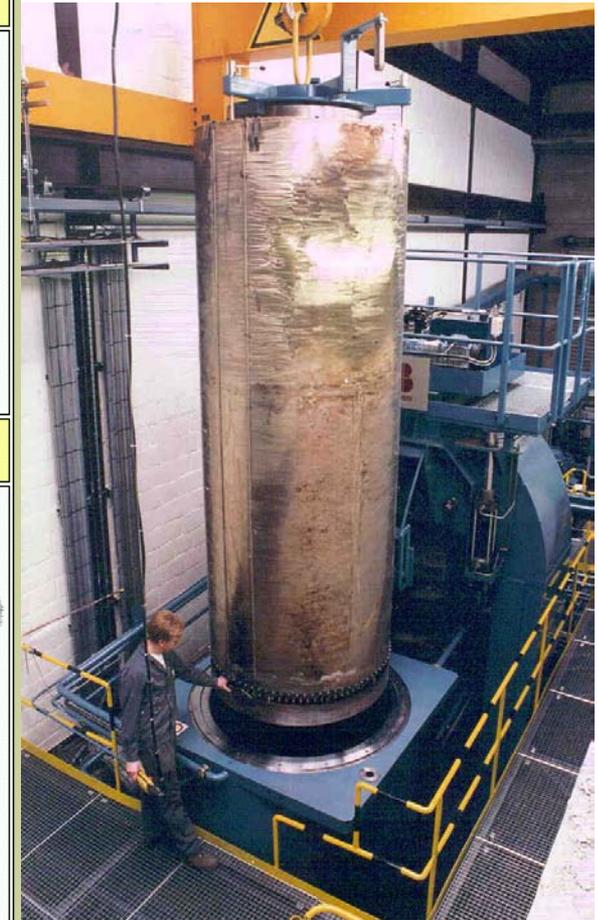
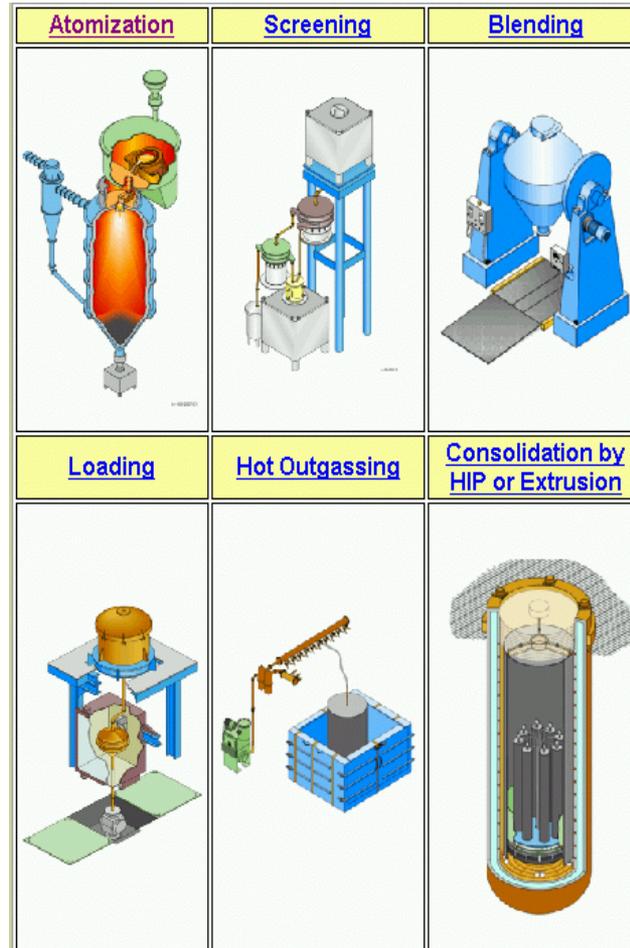
CPM9V, CPM10V, CPM S90V, Material “25”
(either “solid” or with a soft core)

Solid Screw with
Welded Coating

Carbon Steel with Tungsten Carbide weld coating
Stainless Steel with Colmonoy 4 welded crests
Inconel with Colmonoy 4 welded crests



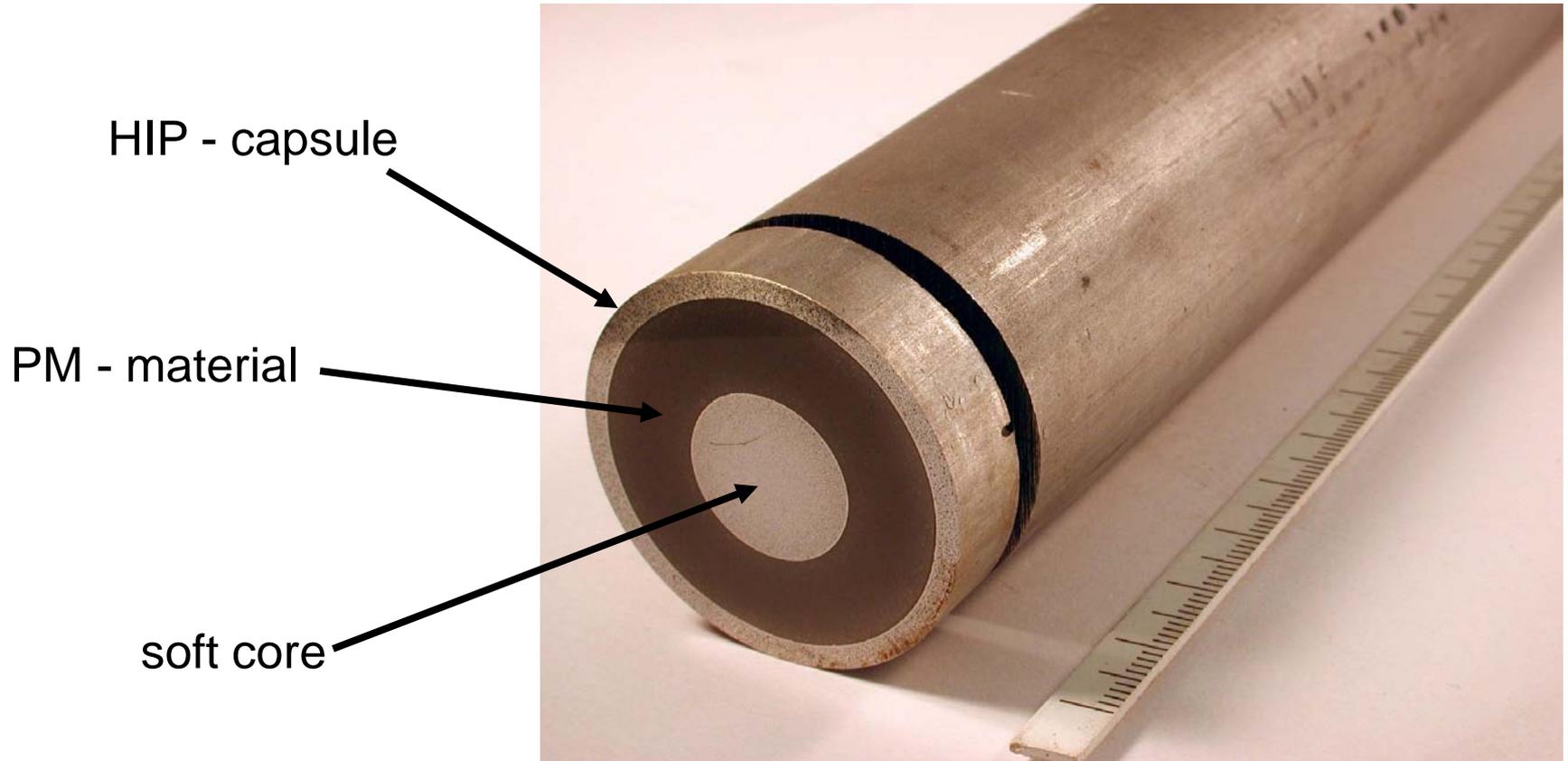
- Hot Isostatic Pressing
(HIP)
- Solid state diffusion
- High pressure
(1000 bar)
- High temperature
(1000 °C +)



ZSK Screw Element Materials

Screw Element Composite Barstock with a Soft Core

Powder Metallurgical HIP Barstock

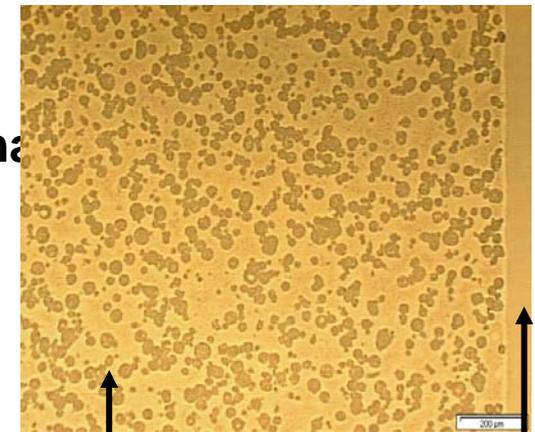


ZSK Advanced Barrel Materials

PROTECT **extreme** 

Coperion's new development of a wear and corrosion resistant material for extruder barrels made of a NiCrBSi-matrix material filled with hard boride and carbide materials.

- Very high abrasive wear resistance
- Very good adhesive and corrosive wear resistance
- Constant distribution of the hard materials in the matrix
- HIP- technology advantage, 3 mm thick HIP Layer
- Layer hardness HRC 63 - 65
- Free of cracks and pores (spider webs)
- Direct application on barrels or oval liners
- Greater than 3 times the lifetime compared to standard wear protection (hard cast chromium steel)



HIP - wear protection layer

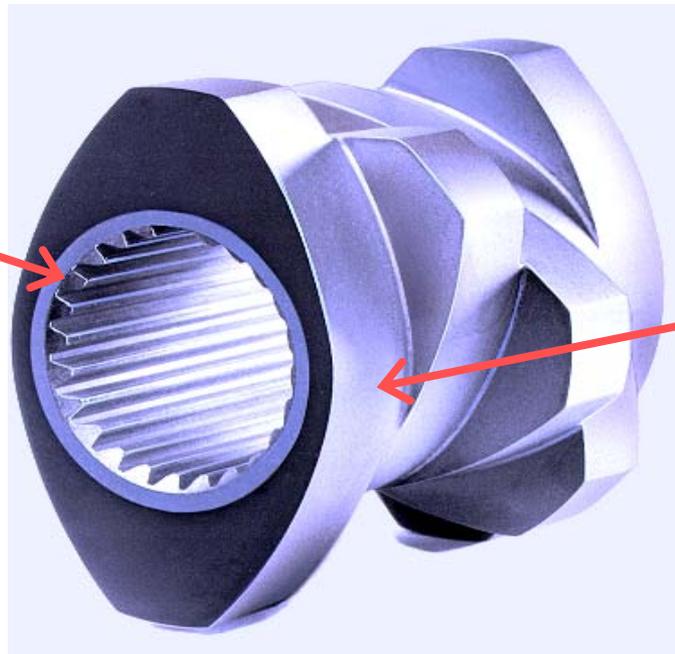
base material

Coperion ZSK Screw Element Materials

Popular Softcore Screw Element Types

<u>Material Code</u>	<u>Softcore</u>	<u>Outside PM Steel</u>
15	Carbon steel	CPM 10V
272	Carbon Steel	S90V Stainless Steel
25	Stainless Steel	X235 Stainless Steel

**Soft
core
steel
sleeve**

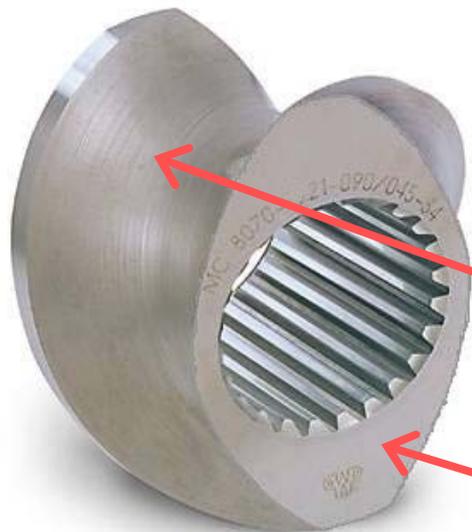


**Through-hardened
powder metallurgical
(PM) steel, chromium
and vanadium carbide
based for wear life**

Coperion ZSK Screw Element Materials

Welded Screw Element Types

<u>Material Code</u>	<u>Body</u>	<u>Weld Overlay</u>
236	Carbon steel	Full TC body weld
245	17-4pH SS	Colmonoy 4 crest weld
229	Inconel 625	Colmonoy 4 crest weld

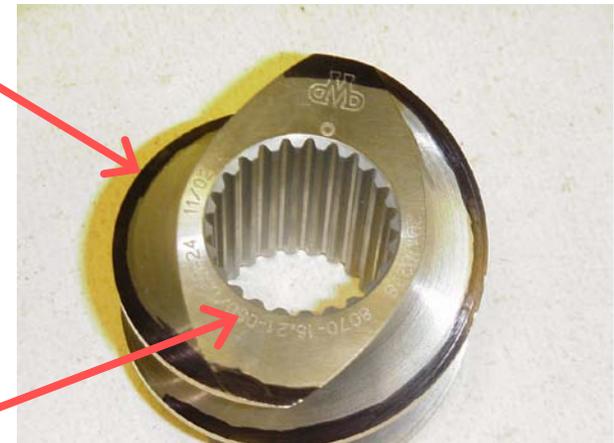


Crest Weld

or

**Full Body &
Crest Weld**

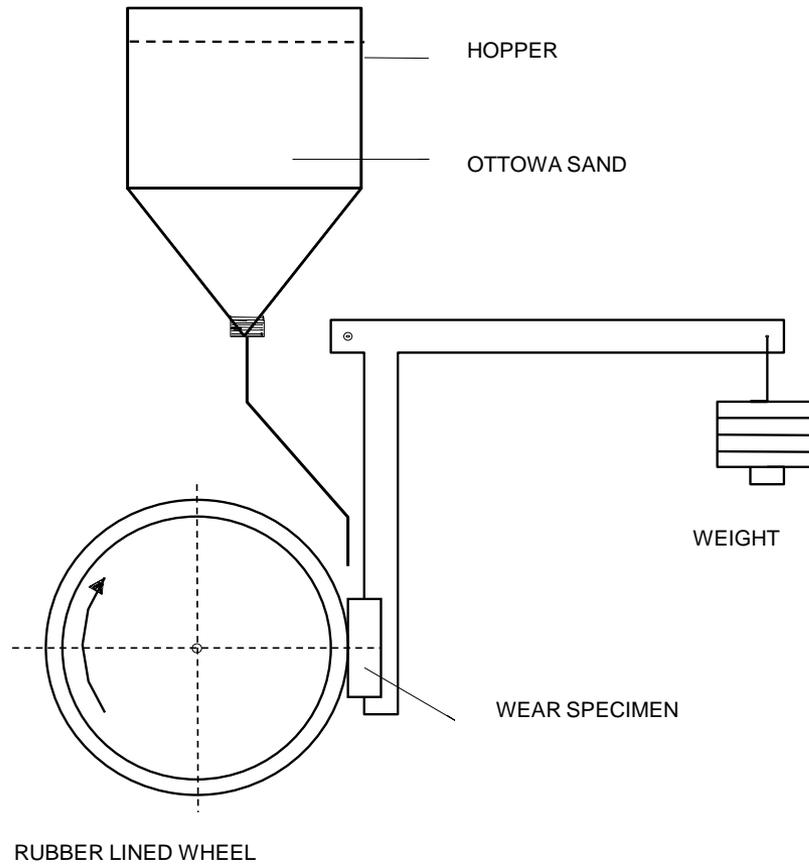
**Body
Material**



ZSK Extruder Screw Wear

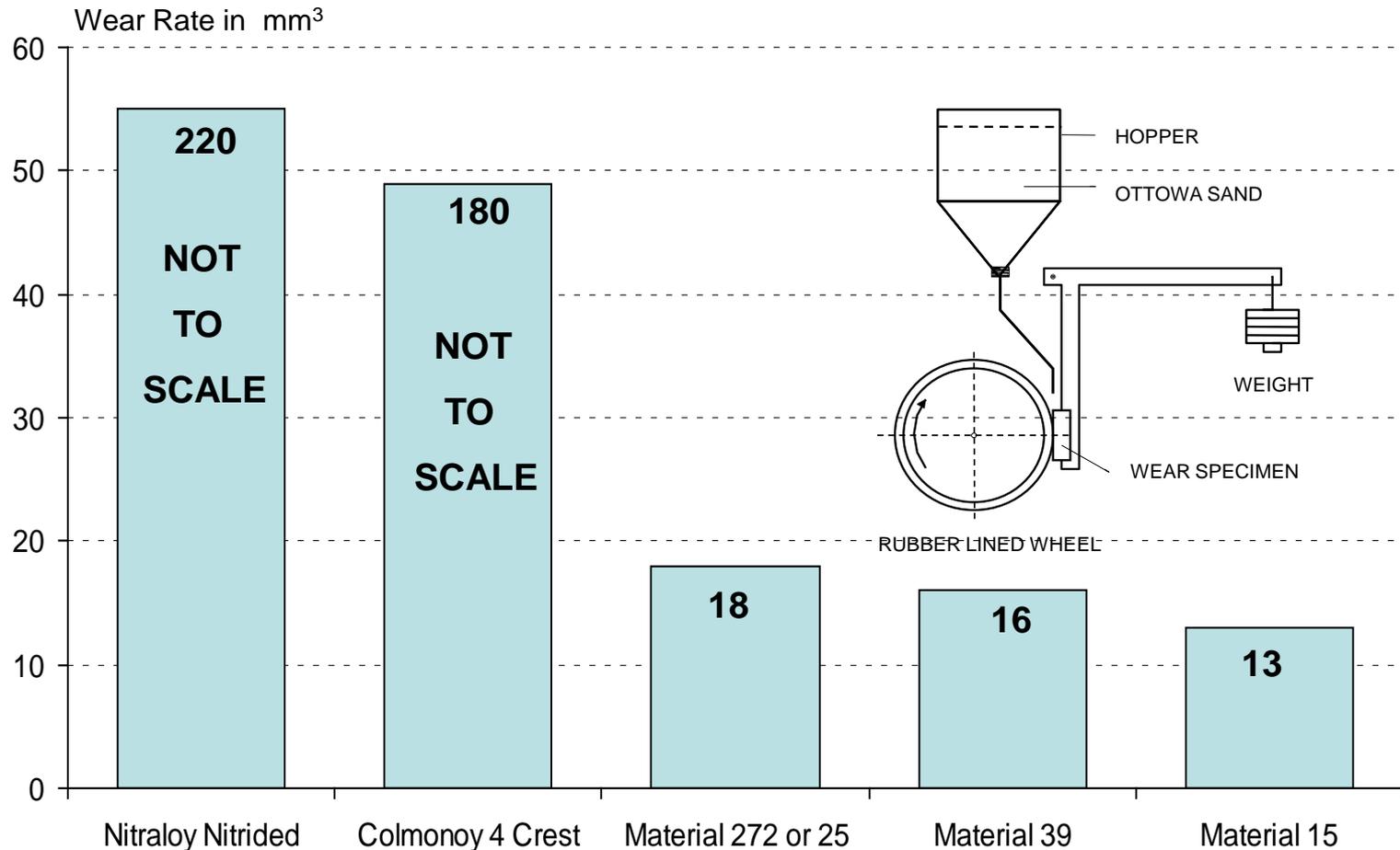
Wear pattern	Displacement of screw shafts	Explanation
		<p>Outward forces</p>
		<p>Inward forces due to the elasticity of the melt</p>
		<p>When the diameter of the screw is reduced very much, screws tend to climb up onto each other.</p>
		<p>Axial displacement of screw shafts.</p>
		<p>Twisting of one screw shafts.</p>

Abrasive Wear Test Set-Up



Abrasive Wear Tests for Screw Material

ASTM-G65 Sand Abrasion Test



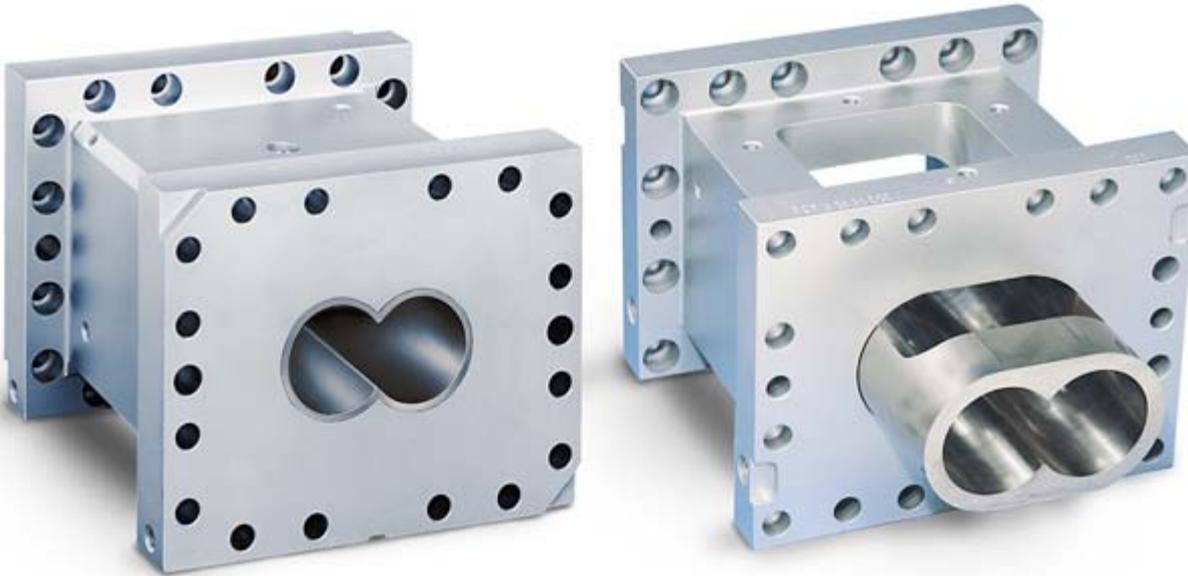
Note: The wear data are based on tests performed in the WP Materials Lab.
The exact wear rate relationships may vary for different applications.

ZSK Extruder Barrel Materials

Barrel or Liner Wear Protection Processes

<u>Process</u>	<u>Application</u>	<u>Examples</u>
Nitriding	direct on barrel	nitrided barrel
Solid thru-hardening liners,	direct or liner	combi barrel, cast oval solid tool steels
Furnace Braze Coating	direct or liners	WPR-29 process
Centrifugal Casting	liners or special design	Xaloy, Wexco
HIP Process HIP65S	direct or liners	CP ^{PROTECT} extreme  Coperion

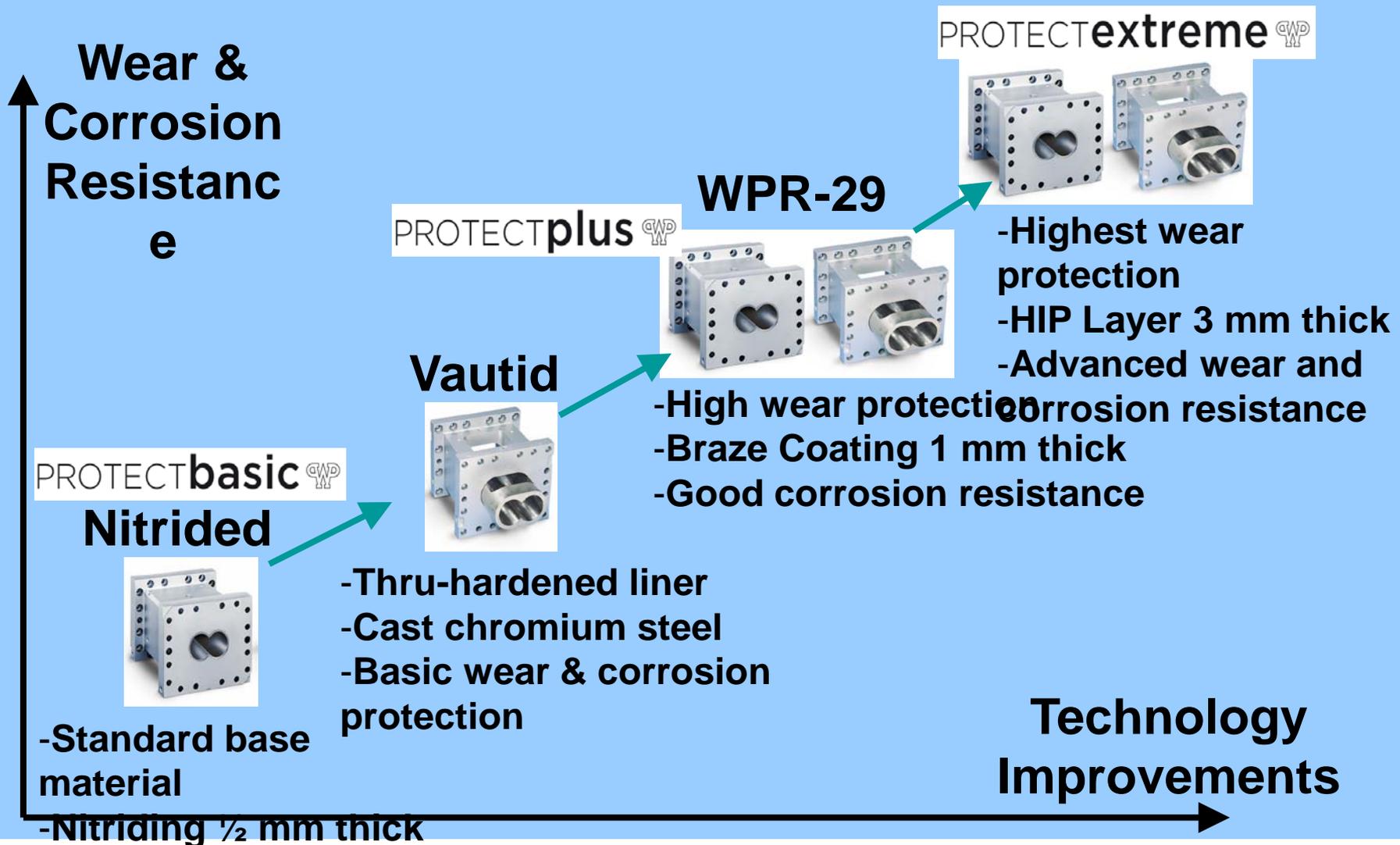
ZSK Extruder Barrel Materials



**Barrel with wear protection
directly applied to the
barrel bore**

**Barrel with
exchangeable
oval liner**

ZSK Extruder Barrel Materials



Coperion ZSK Barrel Materials Optimum Liner Design



Thin Wall "Figure 8"
Liner is not a good
solution for co-
rotating twin screw
extruders

Coperion Design –
Thick wall and a
solid apex area
for stability &
long life

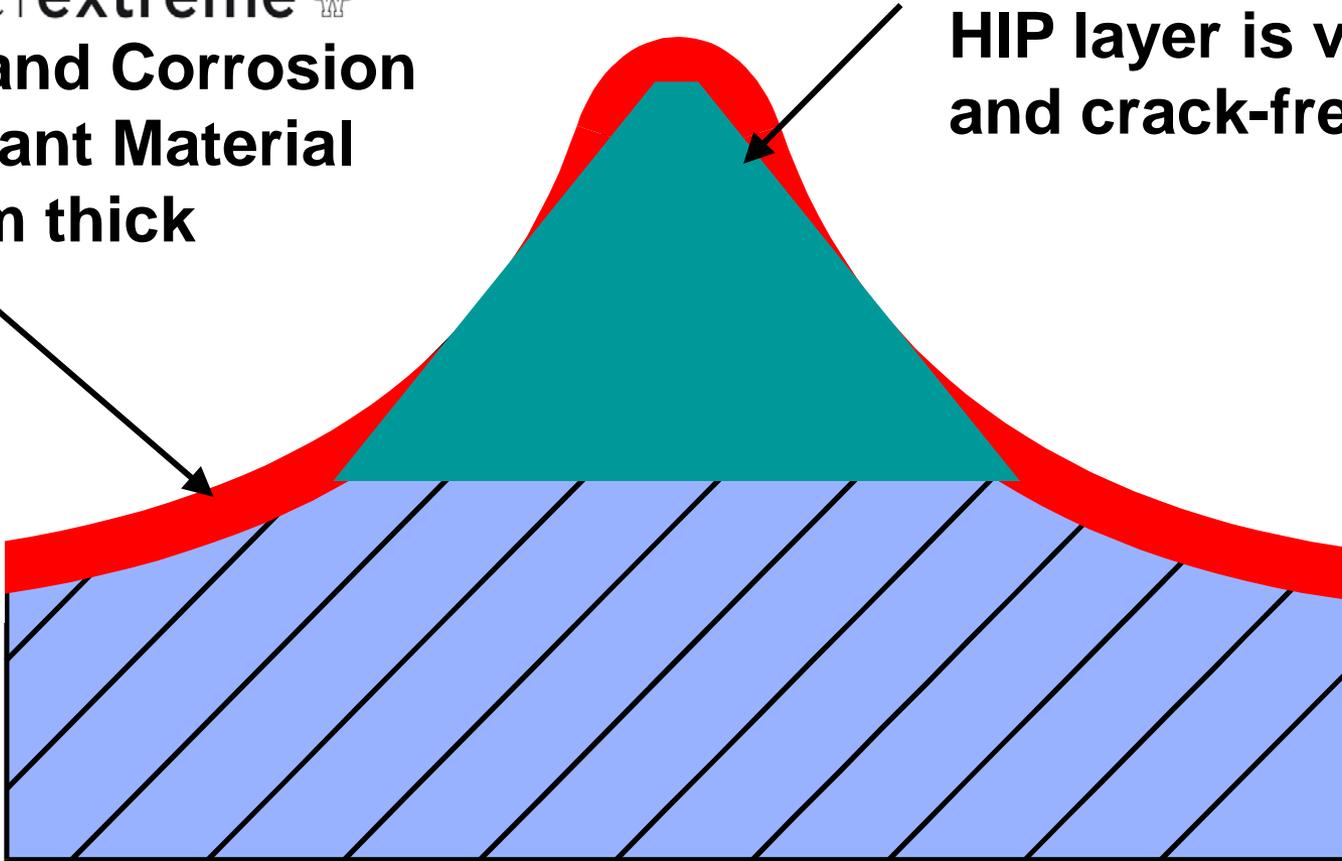


ZSK Advanced Barrel Materials

PROTECT **extreme** 

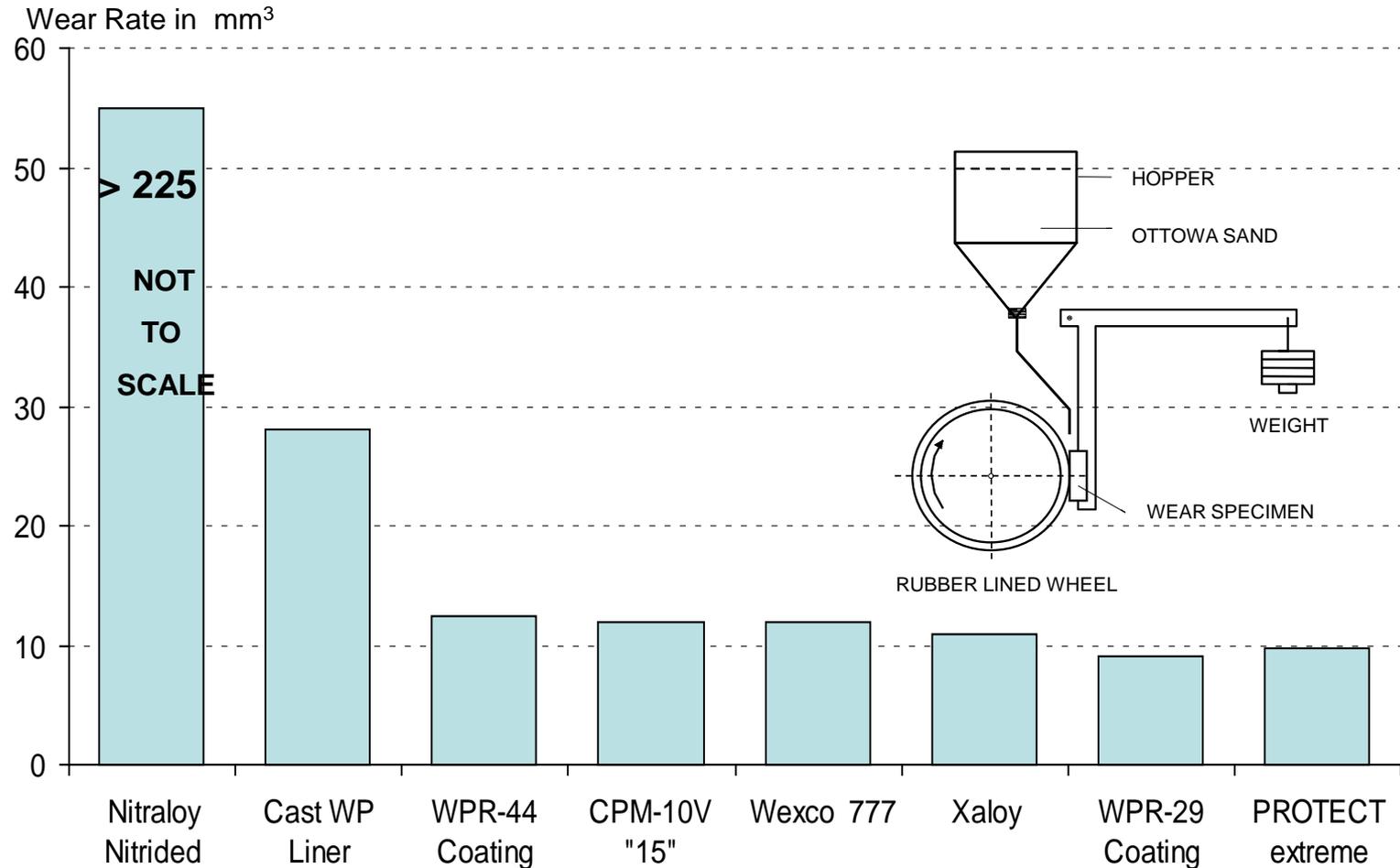
PROTECT **extreme** 
**Wear and Corrosion
Resistant Material
> 3 mm thick**

**Strong apex area
HIP layer is very dense
and crack-free**



Abrasive Wear Tests for Barrel Materials

ASTM-G65 Sand Abrasion Test



Note: The wear data are based on tests performed in the Coperion Materials Lab. The exact wear rate relationships may vary for different applications.

Adhesive Wear Test Simulating Screw/Barrel Friction Conditions

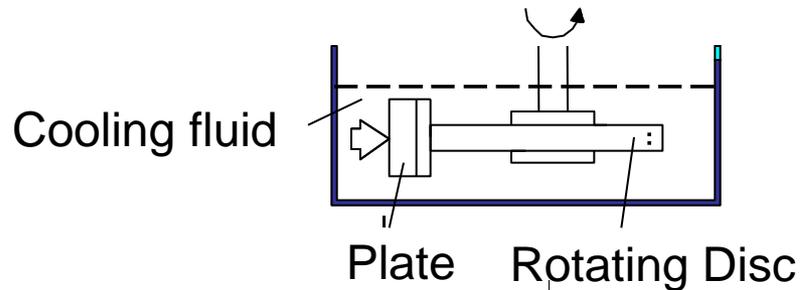
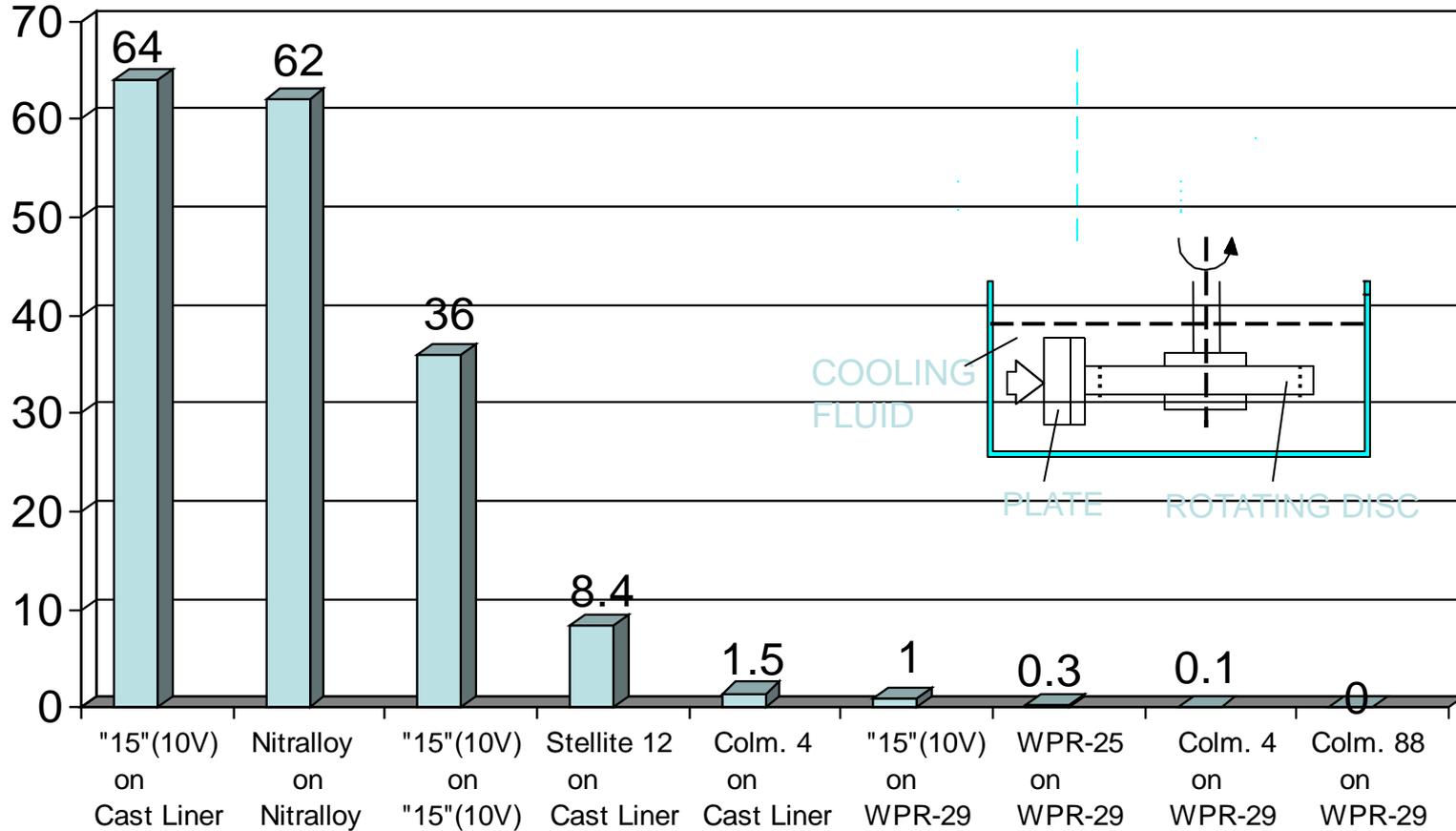


Plate:	Of barrel material, solid material or with applied coating - 100KG constant pressure against disc	Diameter:	100MM
		Surface speed:	100.5 M/Min (5.5 ft/sec)
Rotating disk:	Of screw material, solid material or with coating on outside diameter	Test duration:	5 Hours
Speed:	320 RPM	Cooling fluid:	Standard cutting fluid

Adhesive Wear test for Screw and Barrel Material

(wear rate on plate in cu mm)



ZSK Screw & Barrel Material

Adhesive Wear Compatibility

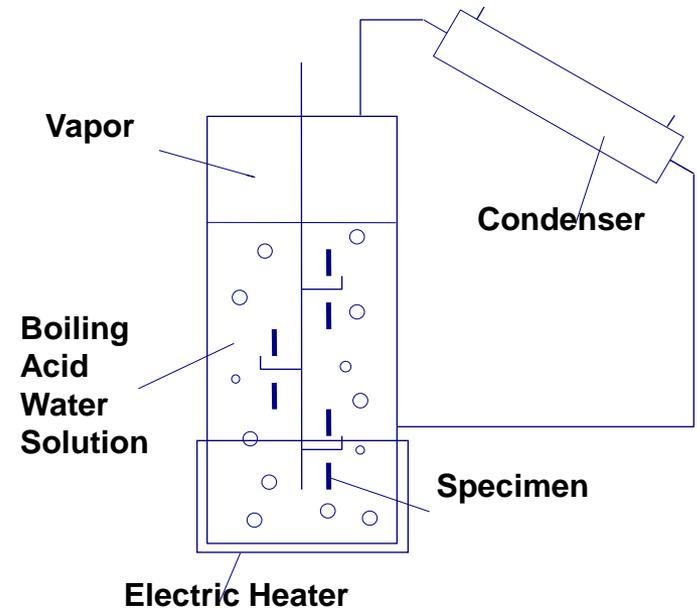
<u>Screw Element Material</u>		<u>Barrel Adhesive Wear Compatibility</u>						
Material Code	Description	Nitrided Steel	Cast "Vautid"	CPM10V	WPR-29	Ni-50/60 or Col 4	Xaloy	PROTECT extreme
00	Nitralloy 135 (Nitrided)			Caution	Caution			Caution
05	Thru-Hardened Stainless Steel			NO	NO		NO	
15	CPM-10V with soft core	NO						
25	MV 11K with 316SS soft core	NO						
39	PM Tool Steel CPM 9V (solid)	NO						
212	Nitralloy with carbide crest weld	NO	Caution			NO		
229	Inconel 625 with Col 4 crest weld							
245	17-4 PH SSI with Col 4 crest weld							
236	Carbon Steel fully carbide welded	NO	Caution			NO		
271 / 272	CPM 420V (272 with soft core)	NO						

Corrosion Test for Screw & Barrel Materials

Specimen Size: 1.5" OD
0.4" Bore Diameter
0.125" Thick

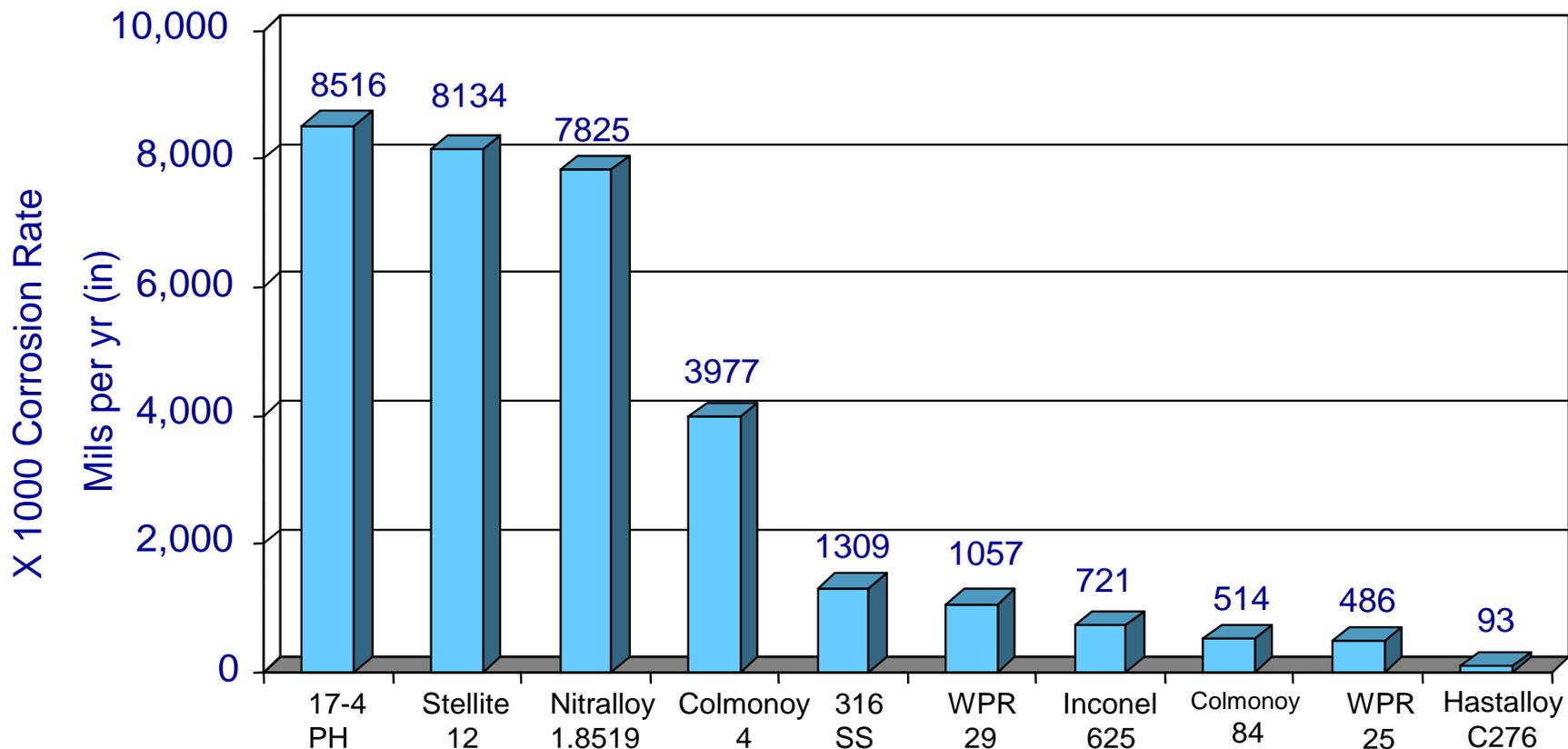
Test Temperature: Boiling temp of
fresh acid/water
solution, held
constant over
test duration

Test Results: Expressed in mils/year
Calculated based on weight loss,
material density, specimen surface & test time.



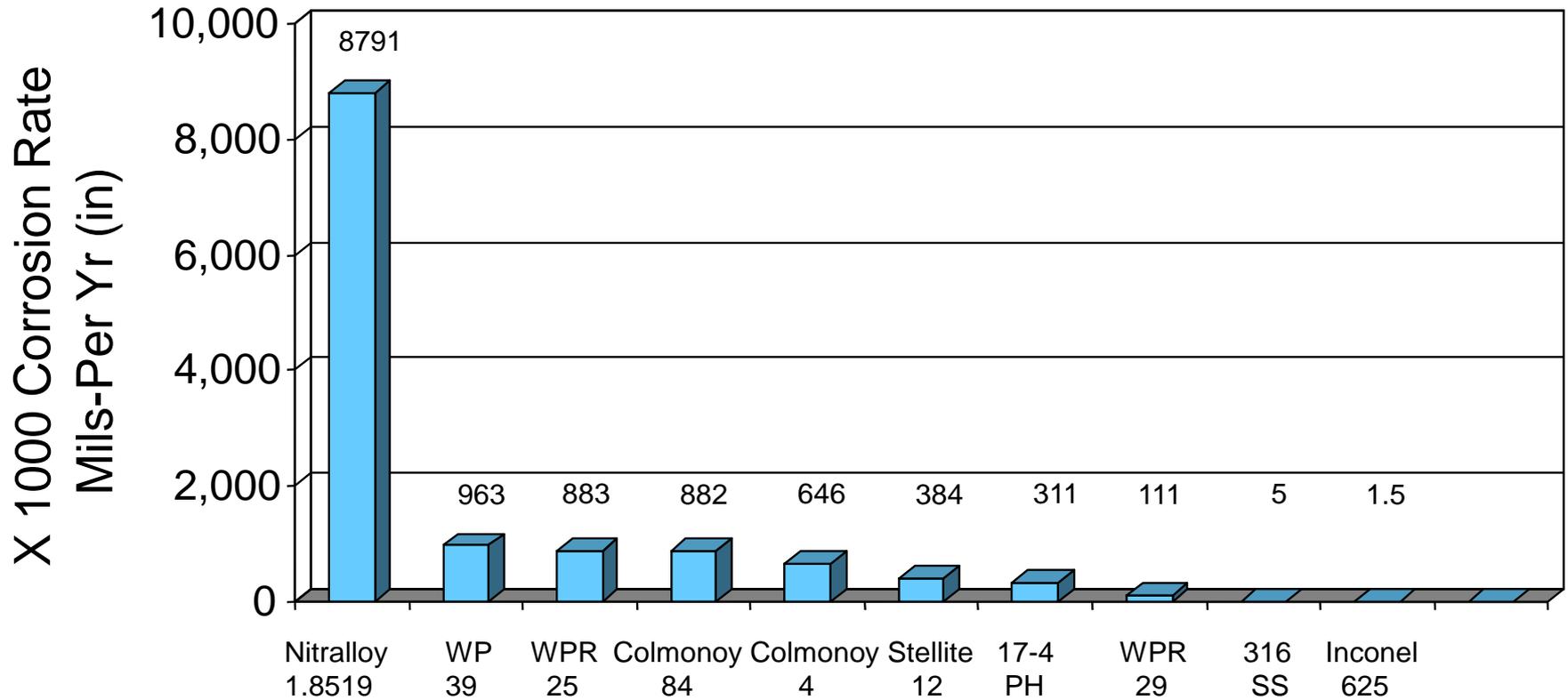
Corrosion Tests for Screw and Barrel Materials

10% Hydrochloric Acid - 100°C - 50 Hrs



Corrosion Tests for Screw and Barrel Materials

5% Sulfuric Acid - 100°C - 50 Hrs



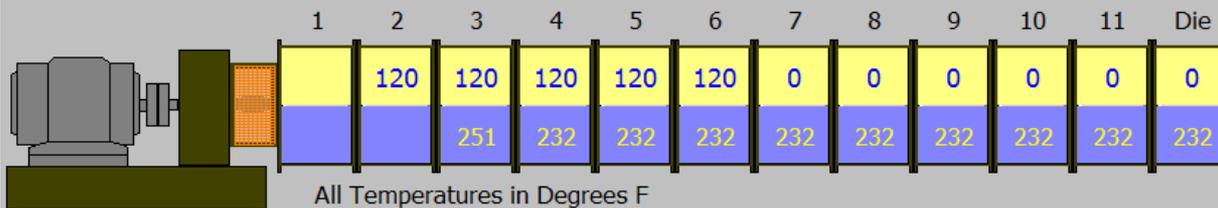
Controls Systems

Feeder	Feeder 1 C BLK	Feeder 2 TI o2	Feeder 3 Stuff	Feeder 4 Liquid	Feeder 5 Ester	Single
Status	Not Ready	Not Ready	Not Ready	Not Ready	Not Ready	Totals
PV Kg/hr	0.0	0.0	0.0	0.0	0.0	0.0
SP Kg/hr	33.0	56.0	0.0	0.0	0.0	89.0
SP %	37.08	62.92	0.00	0.00	0.00	100.0
Net Kgs	0.0	0.0	0.0	0.0	0.0	0.0
Refill	Manual	Auto	Auto	Auto	Auto	



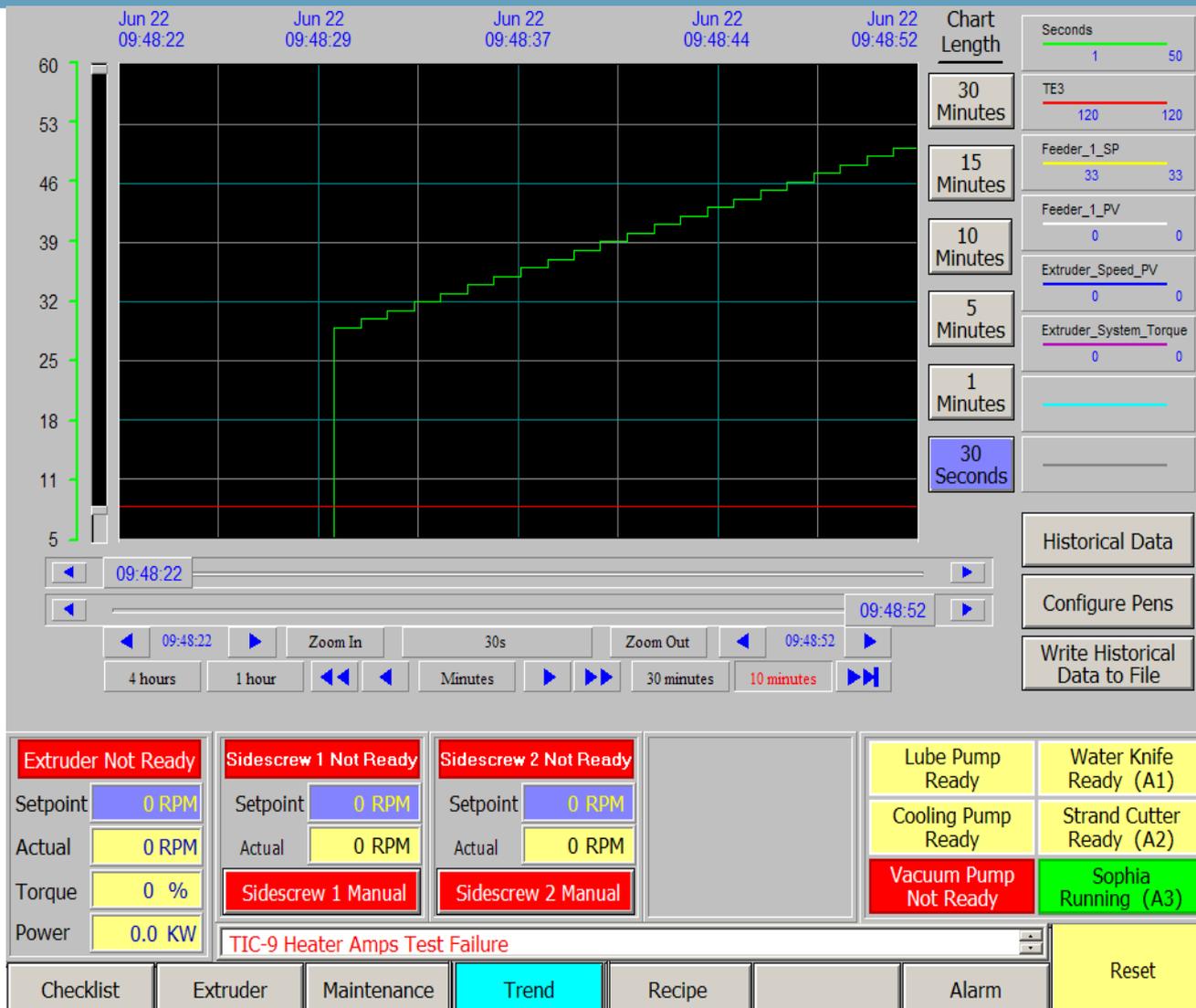
confidence through partnership

Heat-up Incomplete Not at Temperature	Minutes Remaining 3
Heat-up Interlocked	Feed System Interlocked
Set All Temperatures	
Melt Pressure (PSI) #1	-229
#2	-137
Melt Temperature Degrees F	1200



Extruder Not Ready	Sidescrew 1 Not Ready	Sidescrew 2 Not Ready		Lube Pump Ready	Water Knife Ready (A1)	
Setpoint 0 RPM	Setpoint 0 RPM	Setpoint 0 RPM		Cooling Pump Ready	Strand Cutter Ready (A2)	
Actual 0 RPM	Actual 0 RPM	Actual 0 RPM		Vacuum Pump Not Ready	Sophia Running (A3)	
Torque 0 %	Sidescrew 1 Manual	Sidescrew 2 Manual				
Power 0.0 KW	TIC-9 Heater Amps Test Failure					
Checklist	Extruder	Maintenance	Trend	Recipe	Alarm	Reset

Real Time and Historical Trends

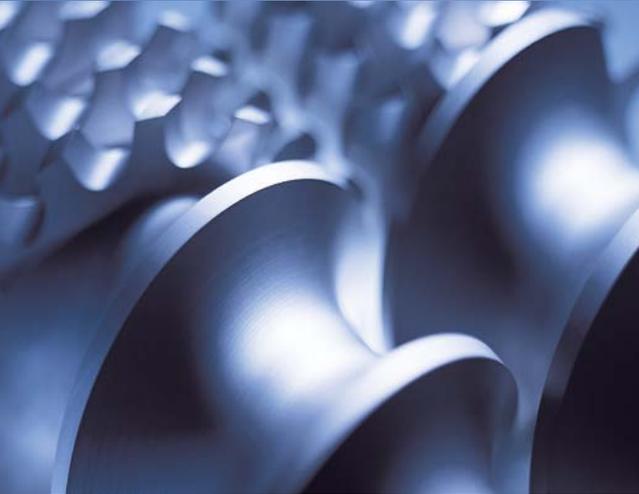


If you need even high rates



Coperion – The Full Service Partner

COMPOUNDING
SYSTEMS.



BULK MATERIALS PLANTS
AND COMPONENTS.



GLOBAL SERVICE.

