Technology of Supported Catalysts

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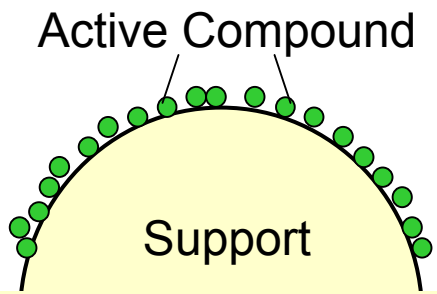
und -technologien

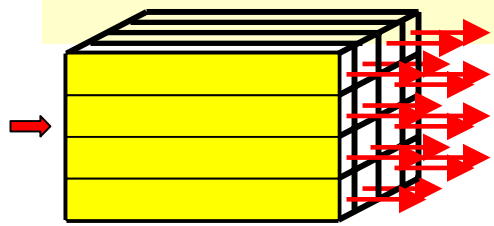
Solid Catalyst Systems

Support	+	Active Compound
Ceramic Honeycombes		Transition Metals
or Powders		Platinum, Rhodium, Palladium, Gold, Titanium, Vanadium



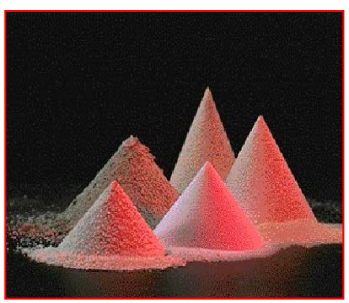
Stiff Supports Systems

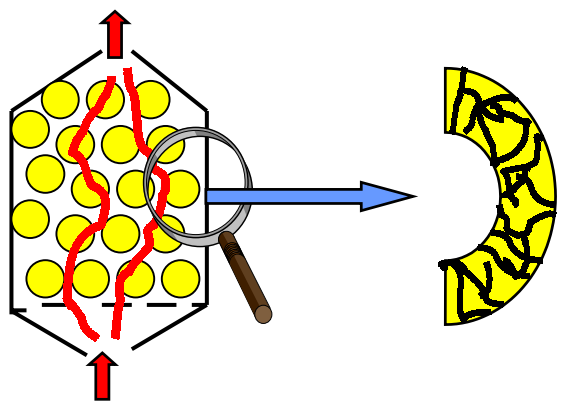
Honeycombe Structures in various shapes



Un shaped Supports:

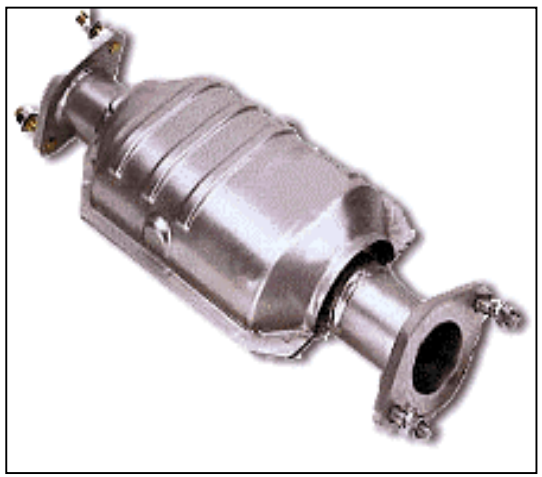
Powder Bed

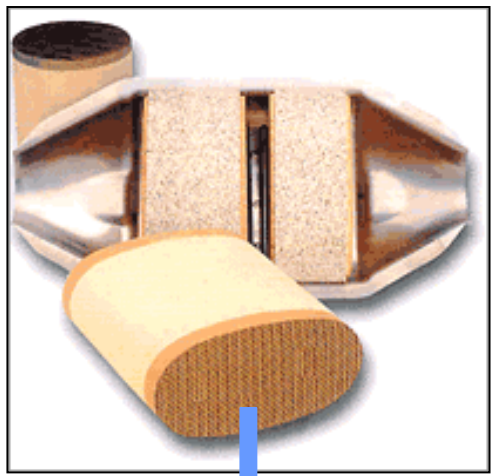


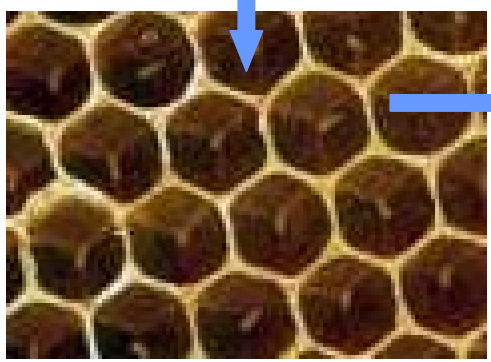


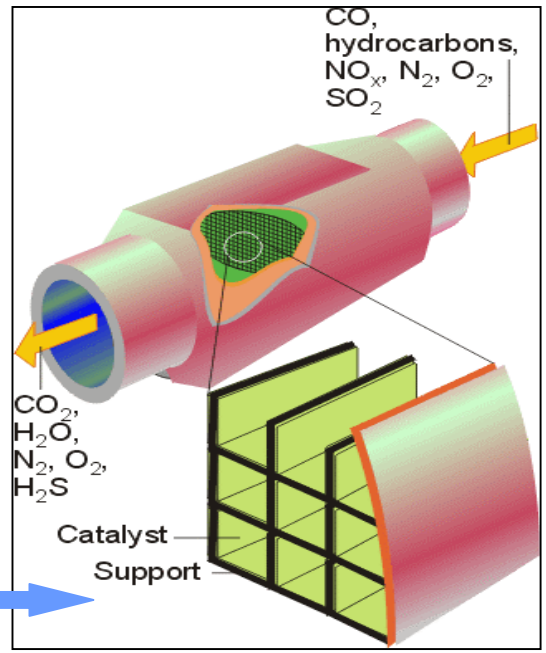
Examples for Technical Catalyst Systems

PKW- Kat

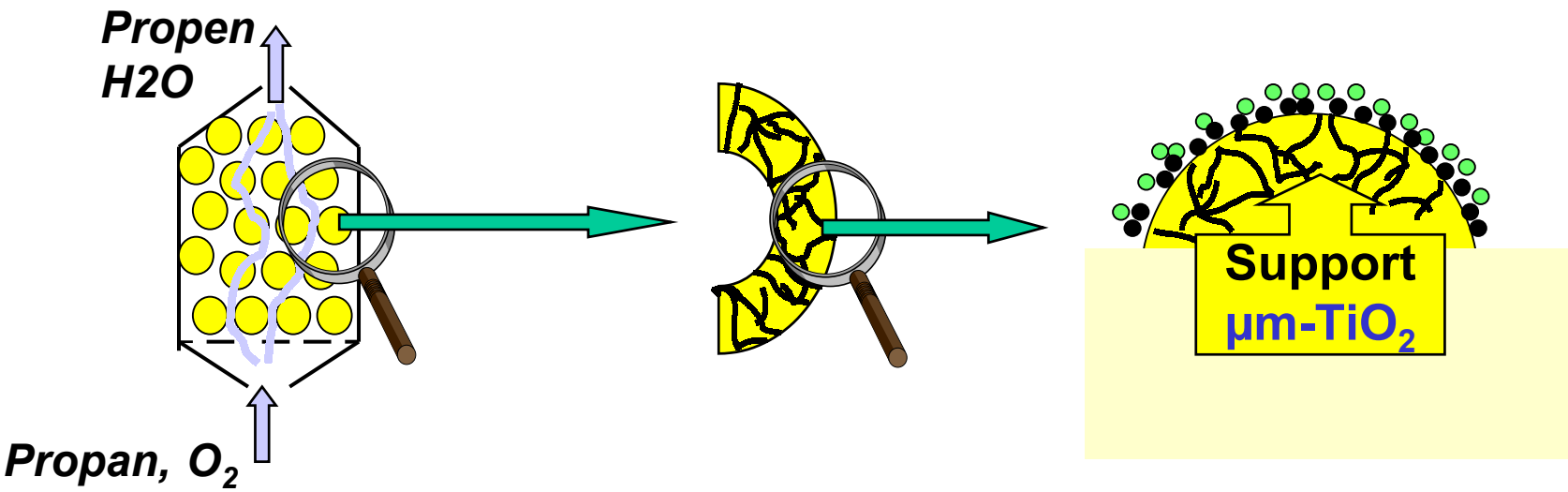






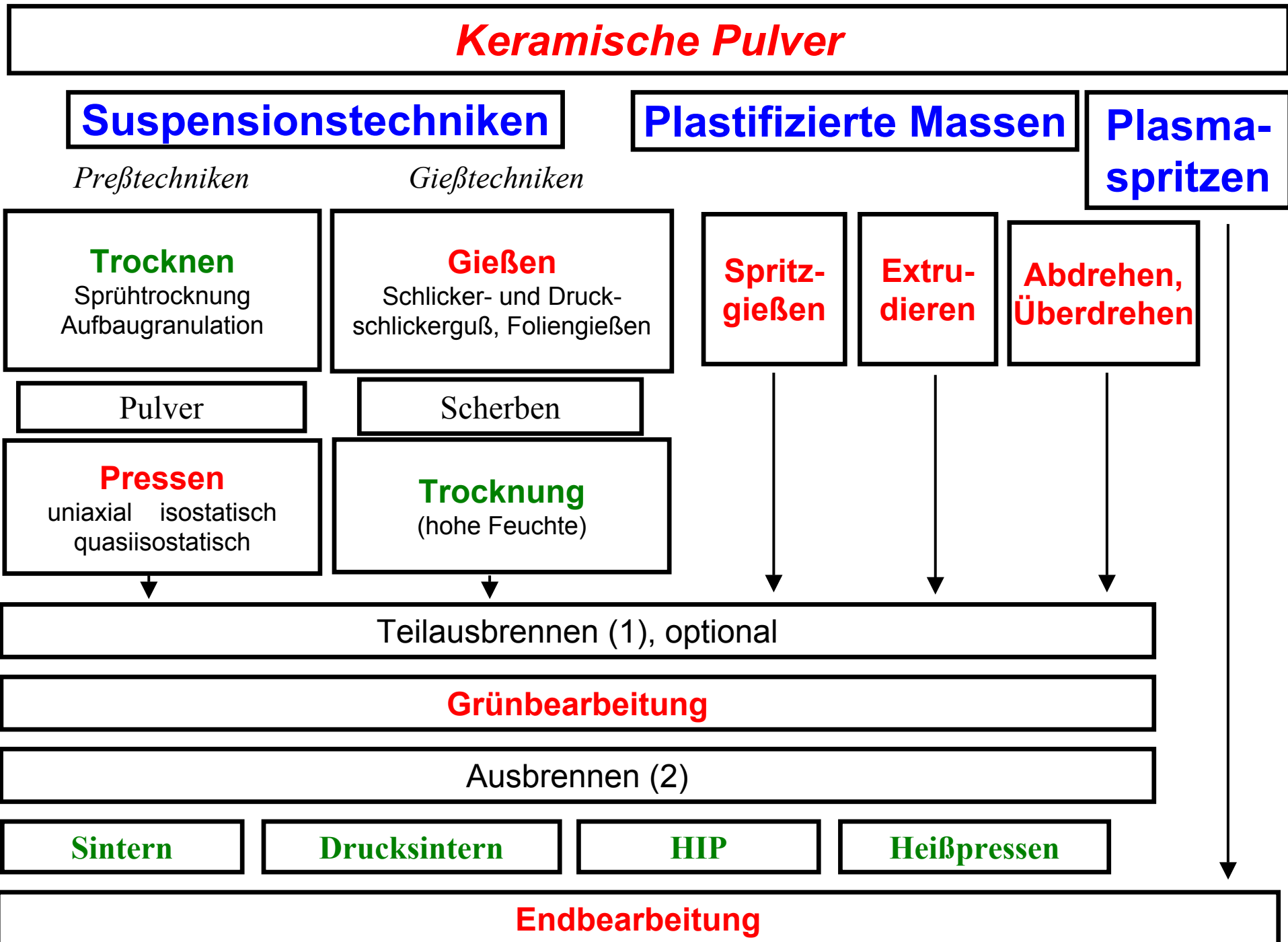


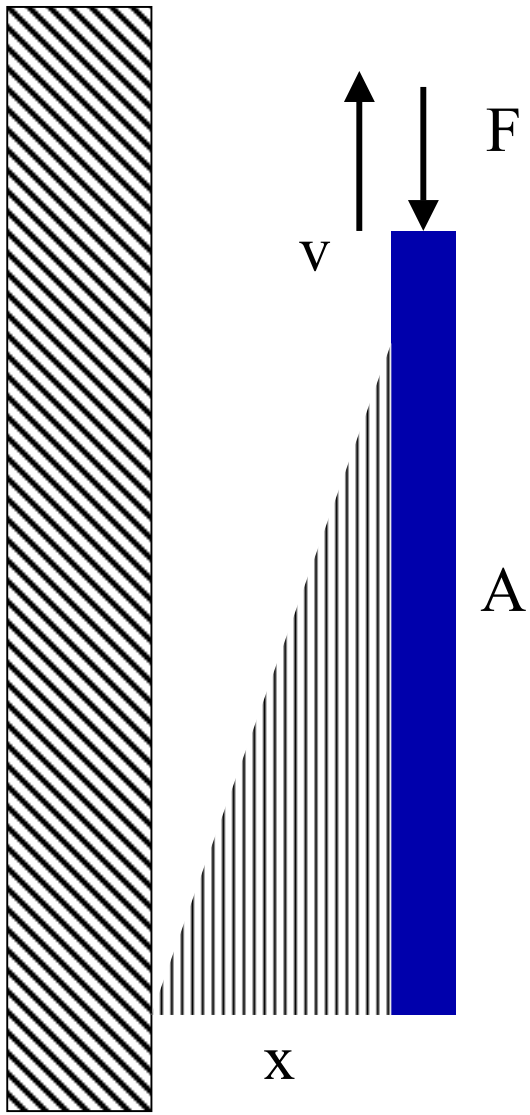
Requirements for a Support



	Pressing Granules	Support
Size of Granules	large	large
Distribution	Wide , high packing density	narrow, large pores
Morphology	Full Granule	hollow
Wall	-	thinn walled
Strength	Long Time Storage but Pressablility	Stable, no shrinkage, no wear

„Wrong“ Granulation !!!


Keramische Pulver
Suspensionstechniken
Plastifizierte Massen
Plasma-spritzen
Preßtechniken
Gießtechniken
Trocknen
Sprühtrocknung
Aufbaugranulation
Gießen
Schlicker- und Druck-schlickerguß, Foliengießen
Spritz-gießen
Extru-dieren
Abdrehen, Überdrehen
Pulver
Scherben
Pressen
uniaxial isostatisch
quasiisostatisch
Trocknung
(hohe Feuchte)
Teilausbrennen (1), optional
Grünbearbeitung
Ausbrennen (2)
Sintern
Drucksintern
HIP
Heißpressen
Endbearbeitung

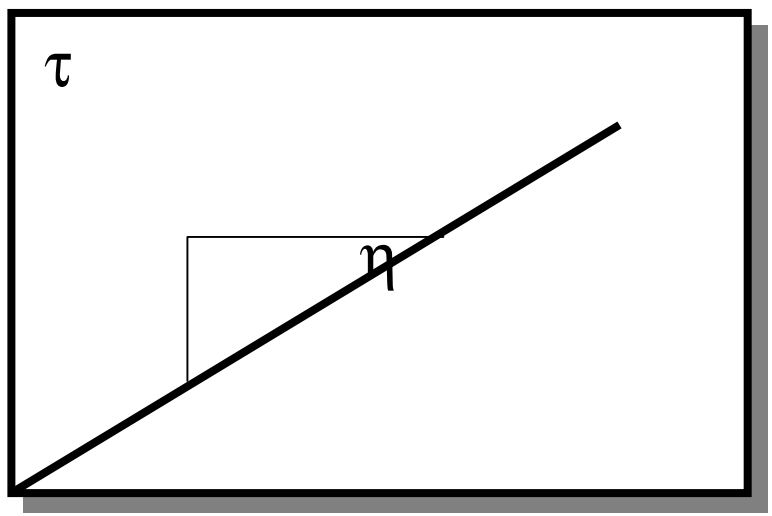


Load = Material Answer

F/A = Parameter dv / dx

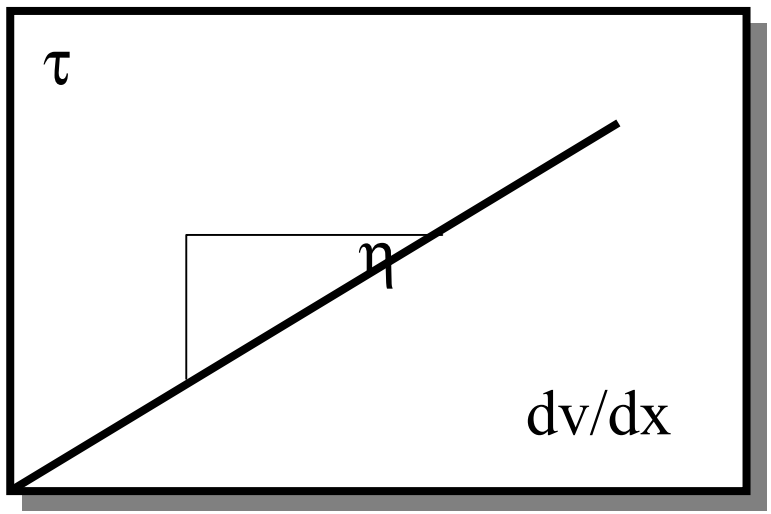
shear stress = viscosity shear rate

$$\tau = \eta \; 1/d$$



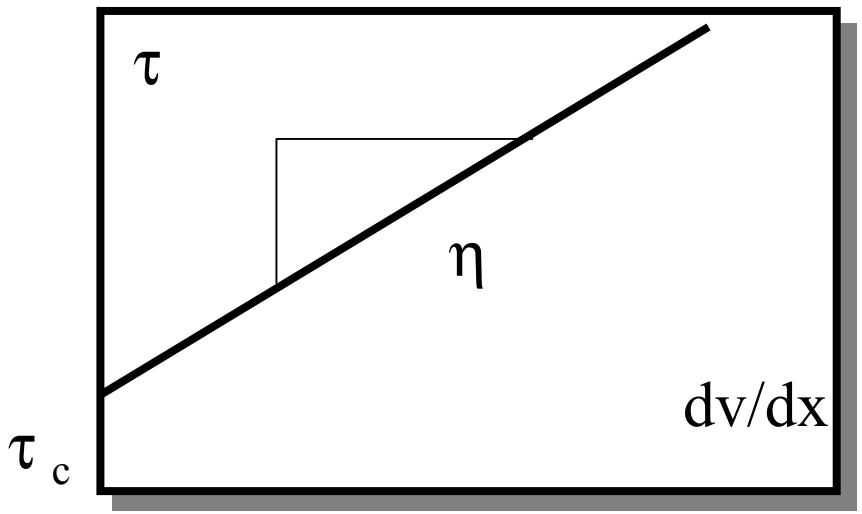
Newton

$$\tau = \eta \ dv/dx$$



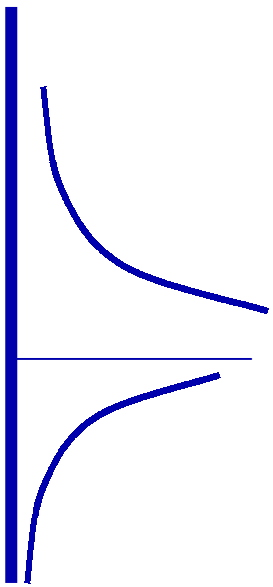
Bingham

$$\tau = \tau c + \eta \ dv/dx$$



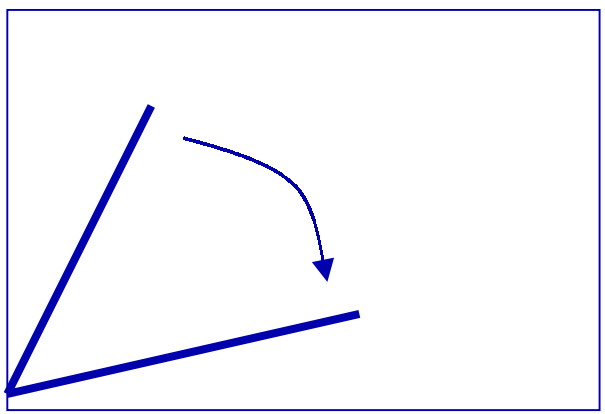
Yield stress, Schergrenze

How to change the flow behavior of a ceramic suspension?

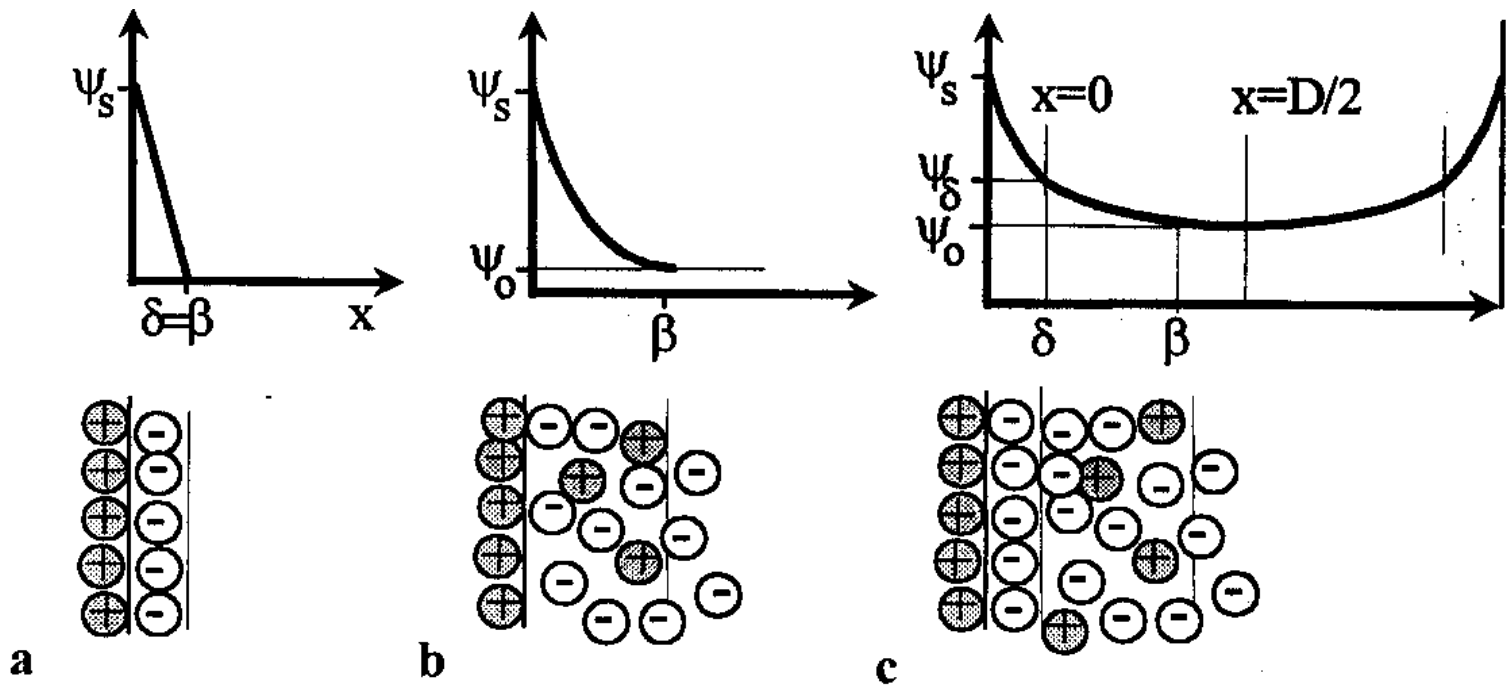


Deflockulant, reduces viscosity

•charges	(Na+)
•steric molecules	(trioleates , Fish oil)
•polyelectrolytes	(amnio-proanole poly-carbonic acids)

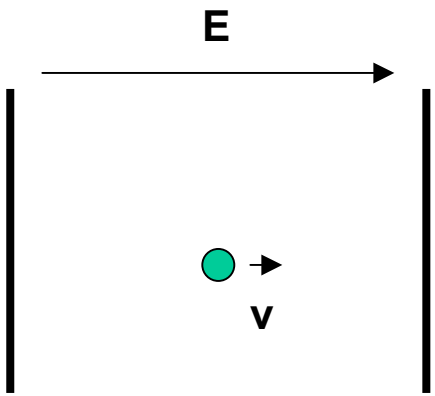


Doppelschichten



Helmholz Guey Stern

Elektrophorese

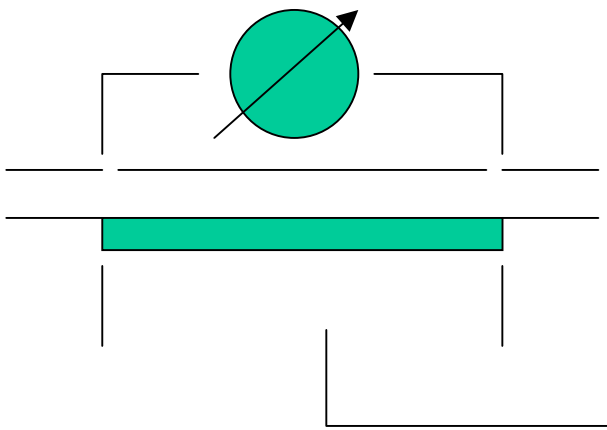


Dielektrizitätskonstante

$$V = \frac{\varepsilon E}{6 \pi \eta} \xi$$

Viskosität

Strömungspotential

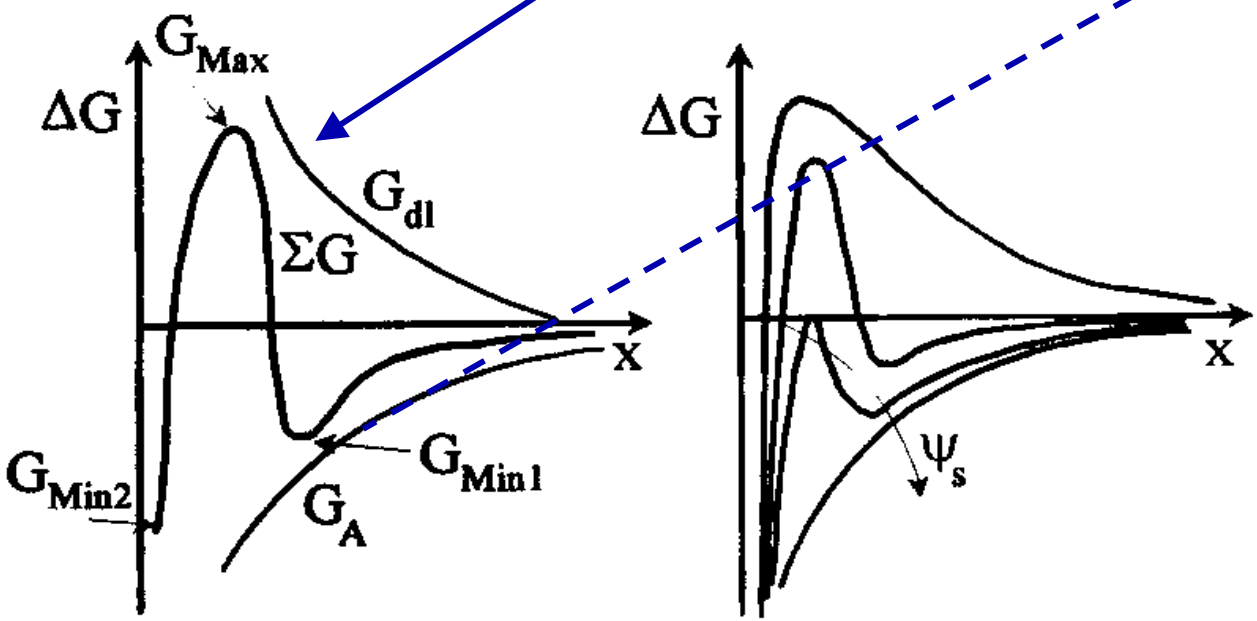


$$\frac{E}{\Delta p} = \frac{\varepsilon}{6{,}75\ 10^{7}\ 4\pi\eta\kappa} \xi$$

Spez. Leitfähigkeit

DLVO Konzept

$$G_{DLVO} = G_{dl} + G_A = \frac{64 \cdot \pi \cdot k \cdot T \cdot R \cdot \rho_\infty \cdot \gamma^2}{\kappa^2} e^{-\kappa \cdot D} - \frac{A_H \cdot R}{6 \cdot D}$$



Darvan C

COOH - CH2 - CH3

KV 5088

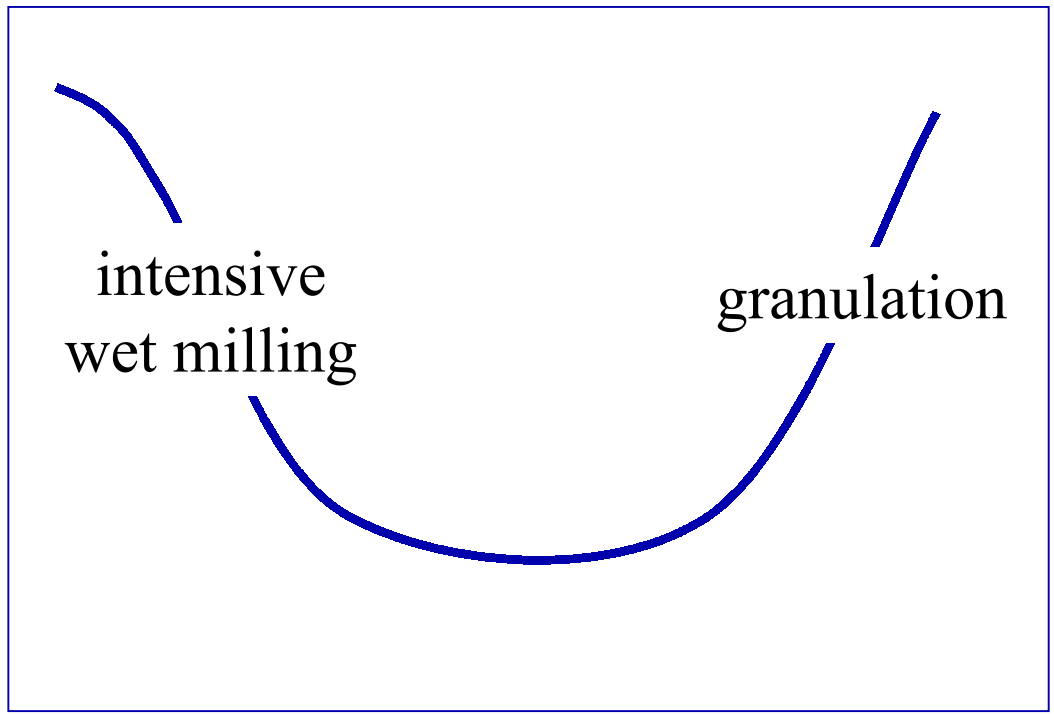
2-amino-2-methyl- propanole

Manhaden Fish Oil (after desoxidation)

-C- ------- OH
-C- ------- OH
-C- ------- OH

Feed stock
•raw materials
•additives
•organics

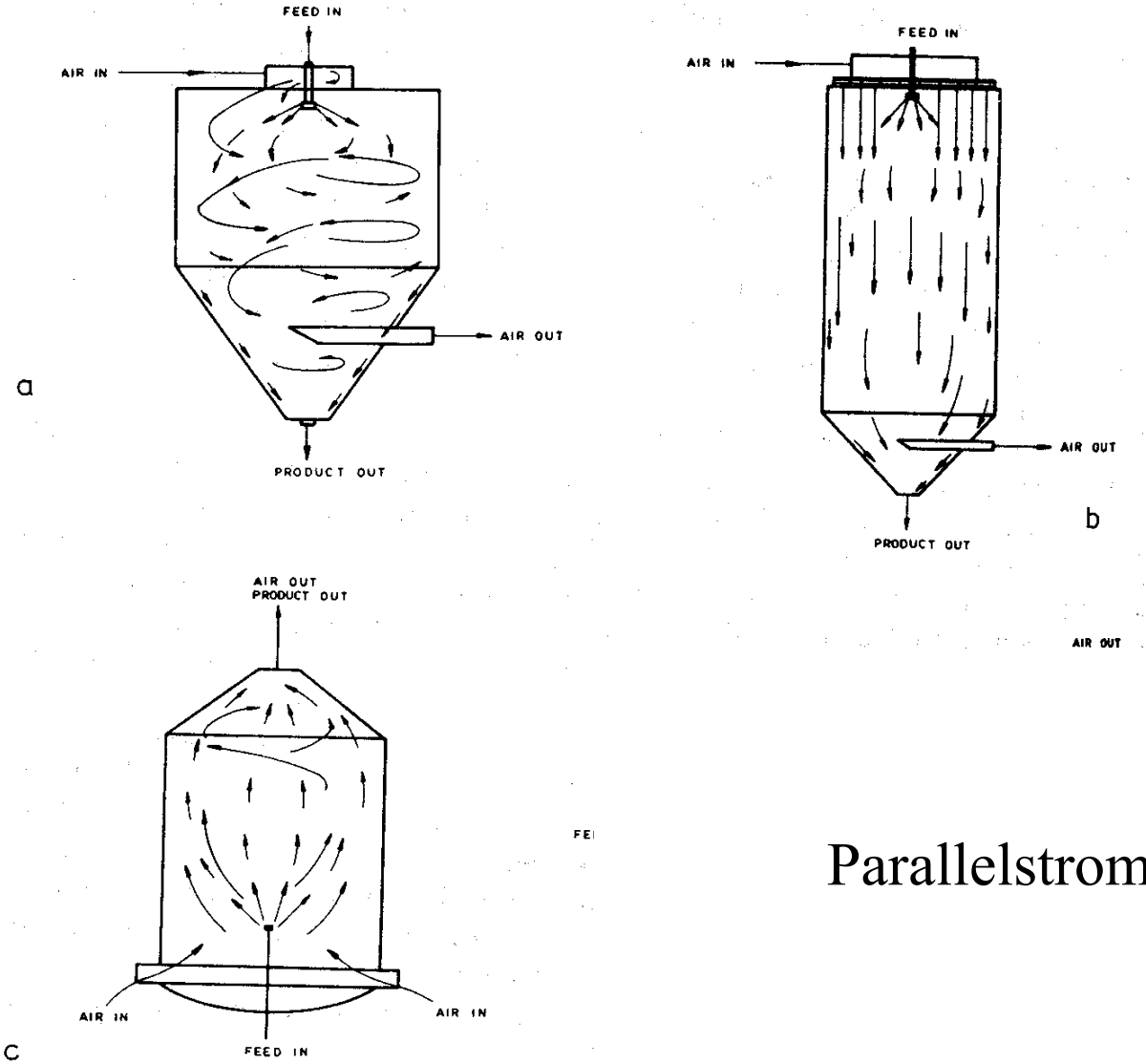
Product
•granulate



> 100µm, heterogeneous
non dispersable: aggregate
dispersible: agglomerate

~ 0.1-3 µm: particle

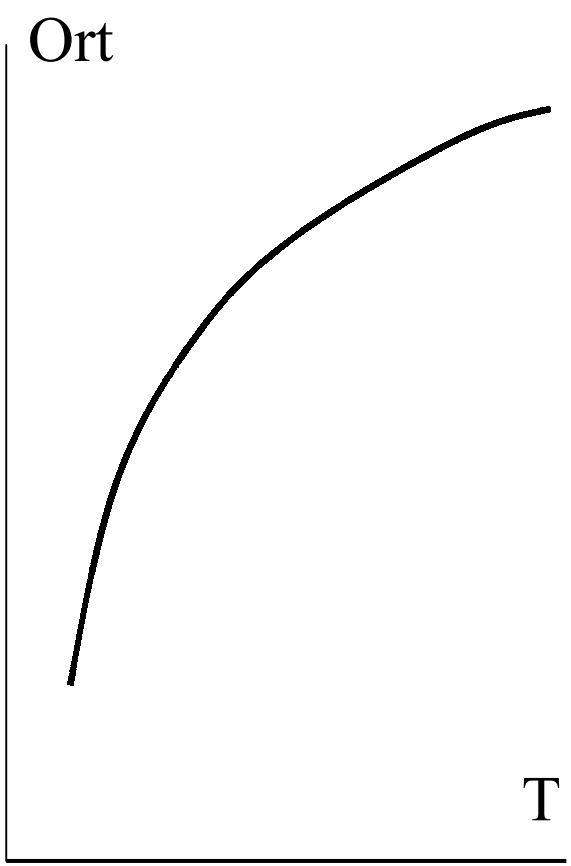
nm: crystallite

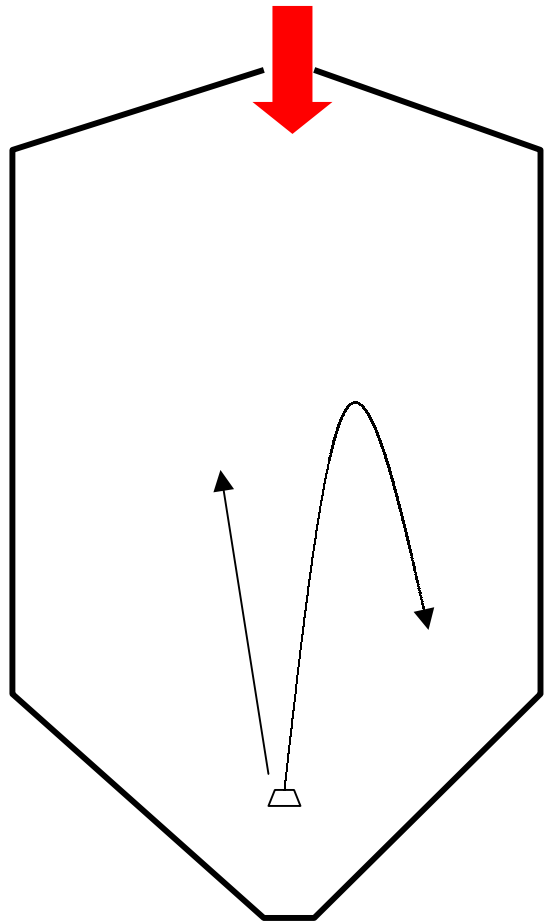


Parallelstromtrockner

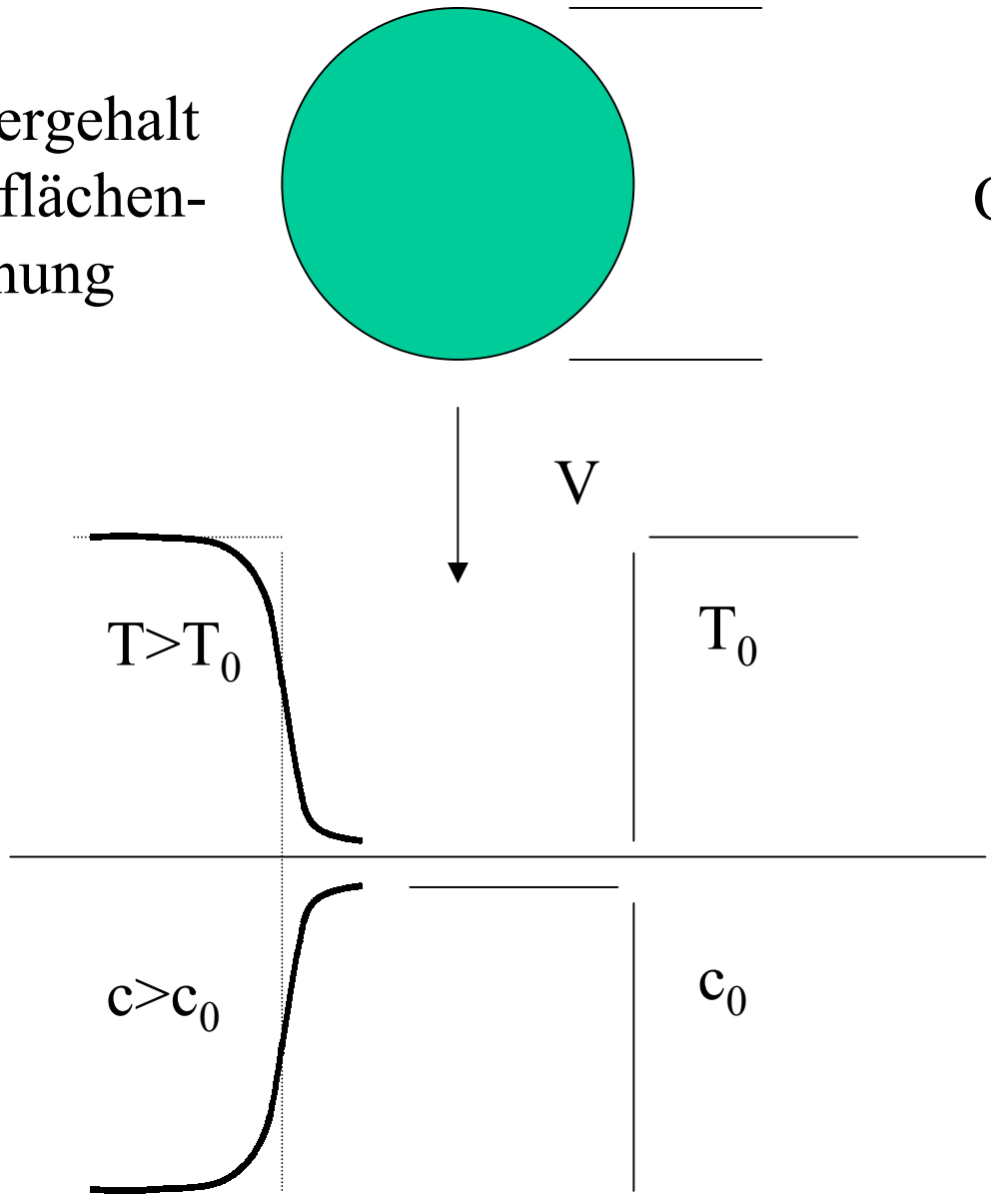
Figure 4.8 Co-current-flow dryers
a *Downward rotary flow*
b *Downward parallel flow (streamline)*
c *Upward flow*
d *Horizontal flow*

Gegenstromtrockner



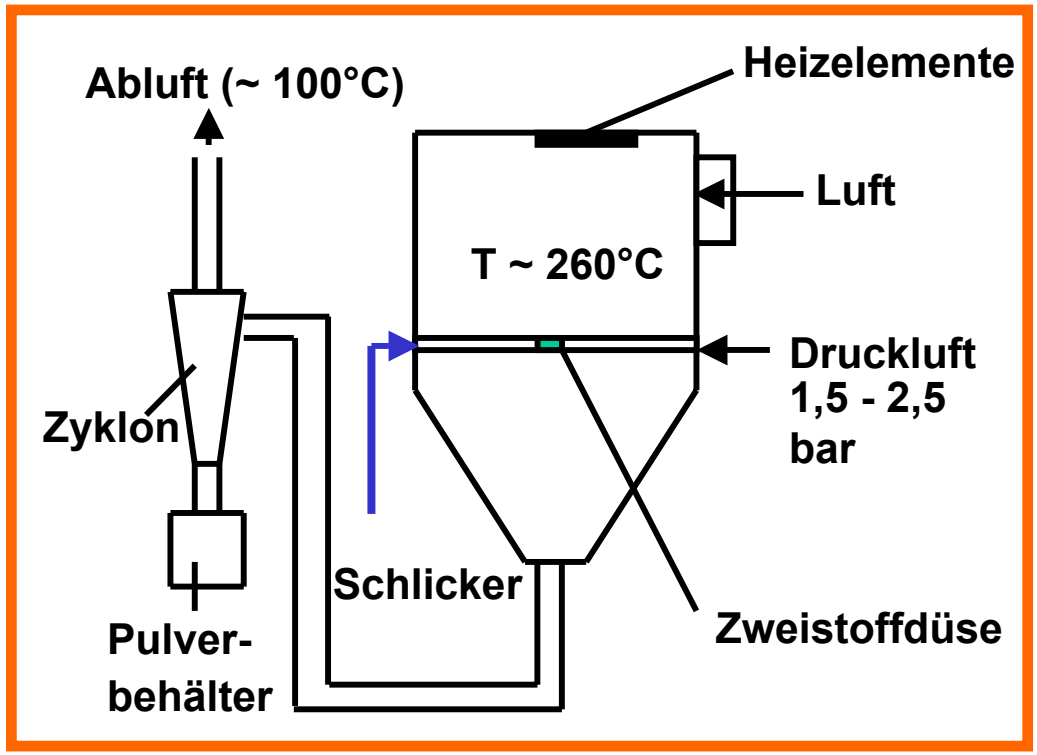


d, ρ,
Bindergehalt
Oberflächen-
spannung



Staudruck vs
Oberflächenspannung

Support Processing of µm-TiO_2 by Spray Granulation



Spray Dryer (Anhydro)

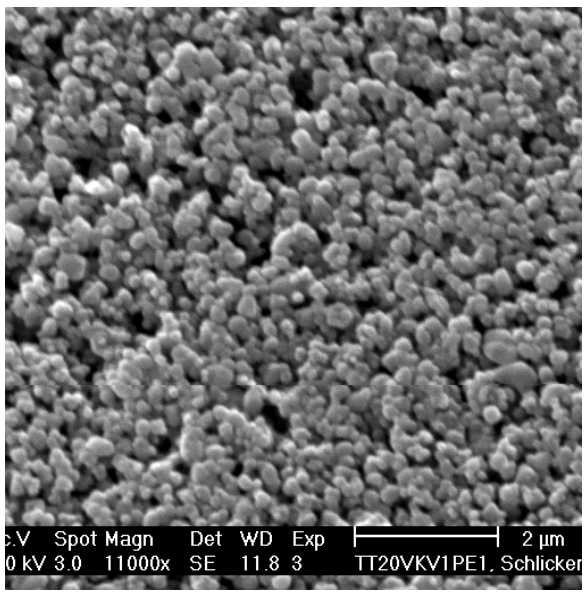
Large Scale Examples:

Milk Powder, Washing Detergents

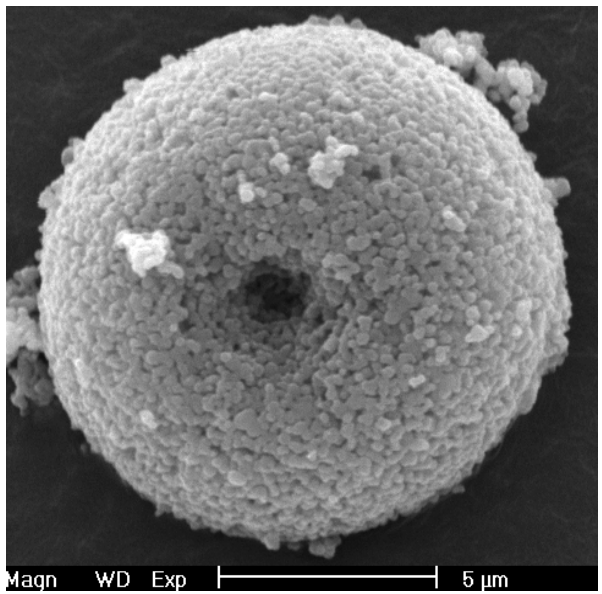
Food Spices (Maggi)

TiO_2- Spray Granulation

Granulation: from 0,6 µm up to > 20 µm

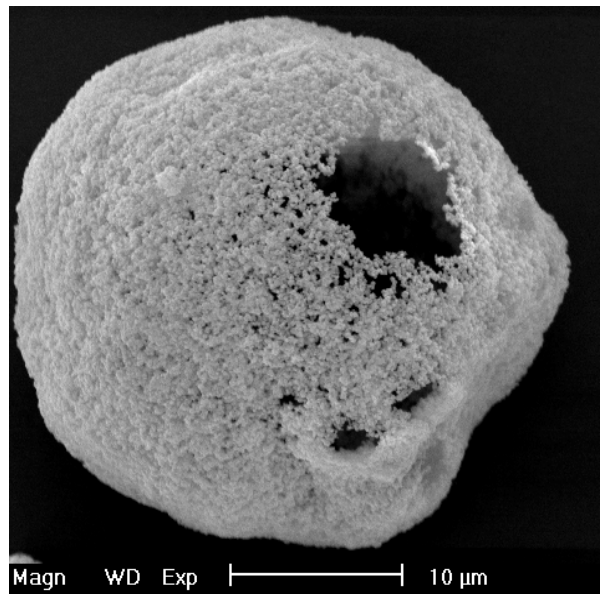


Starting Powder



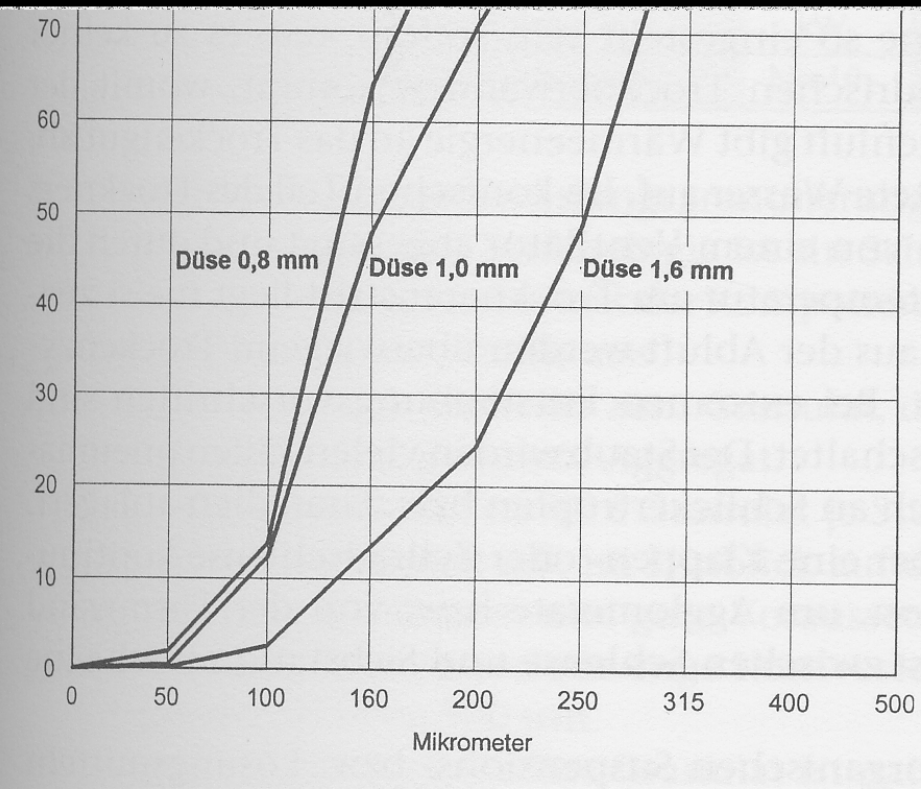
Filled Granule

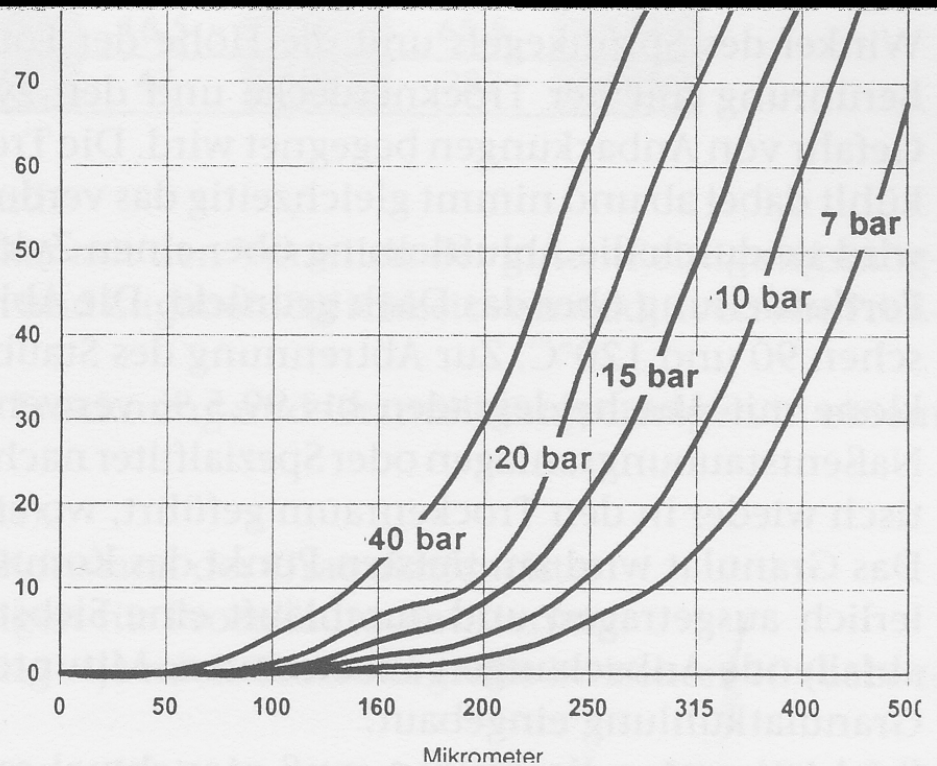
Solid Content
50 Masse%

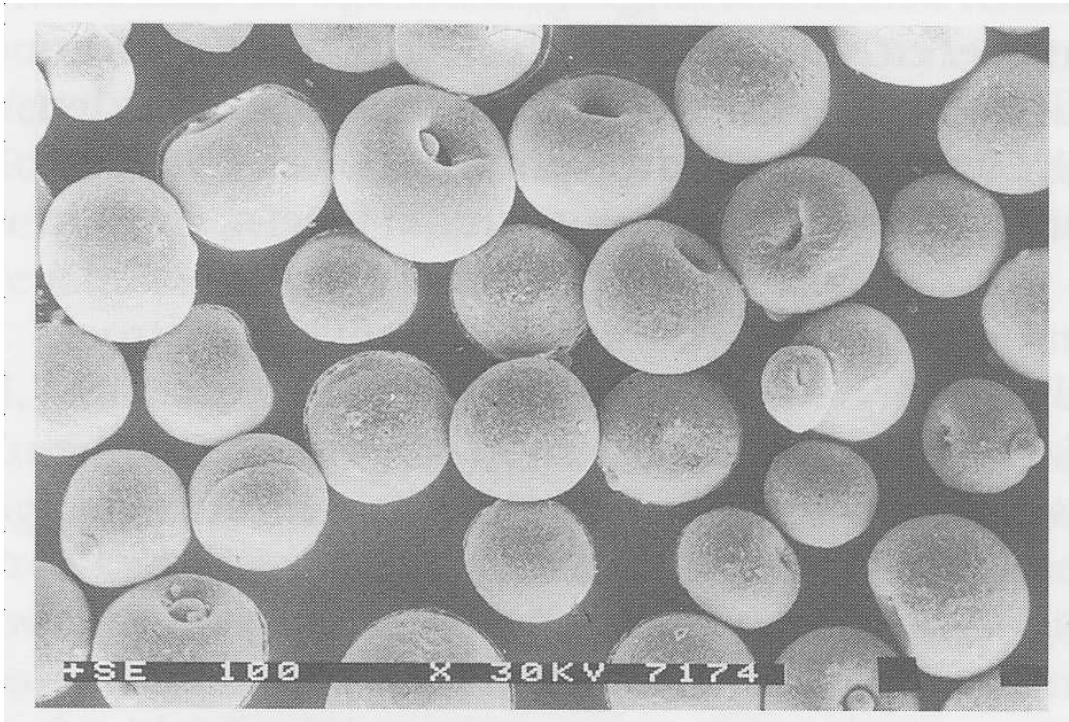


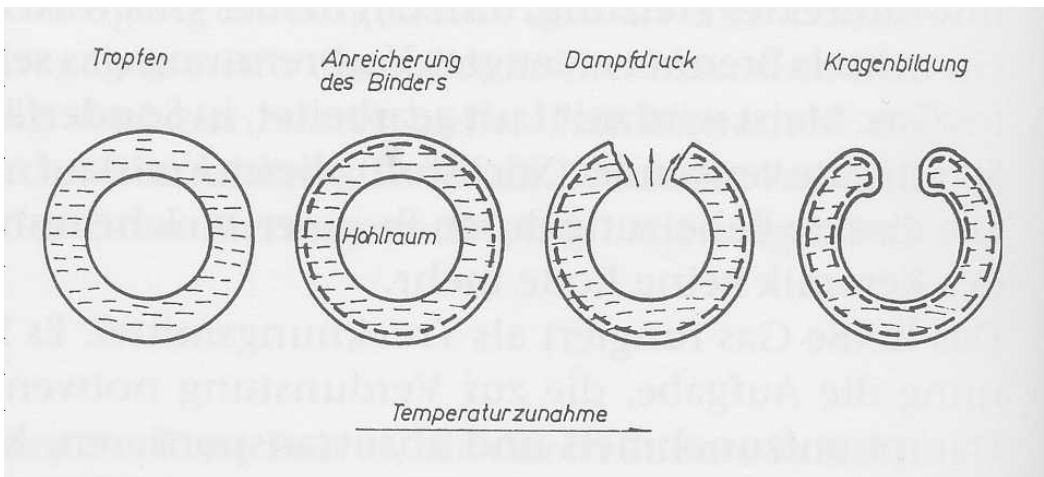
Hollow Granule

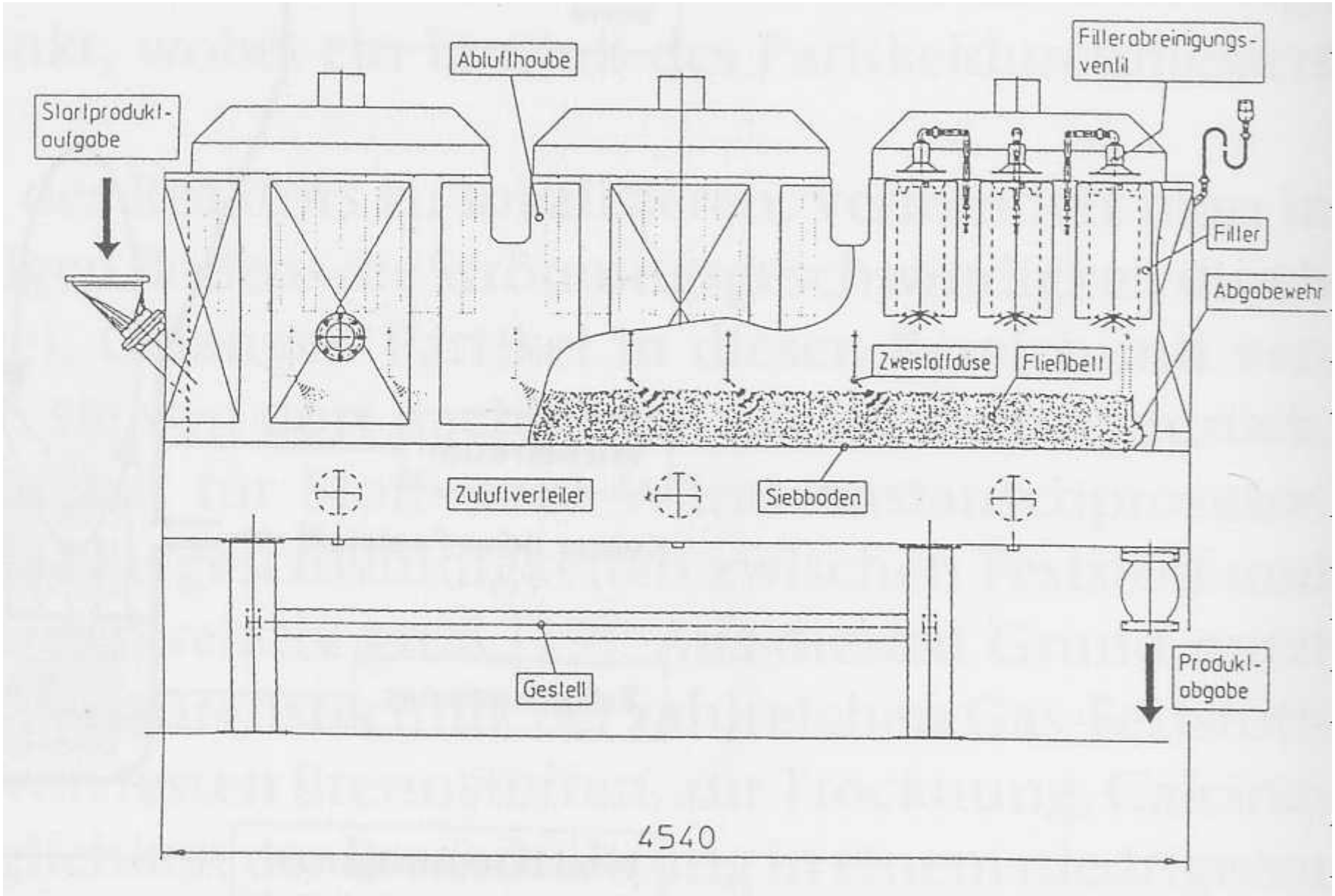
Solid Content
20 Masse%


70
60
50
40
30
20
10
0
Düse 0,8 mm
Düse 1,0 mm
Düse 1,6 mm
0
50
100
160
200
250
315
400
500
Mikrometer

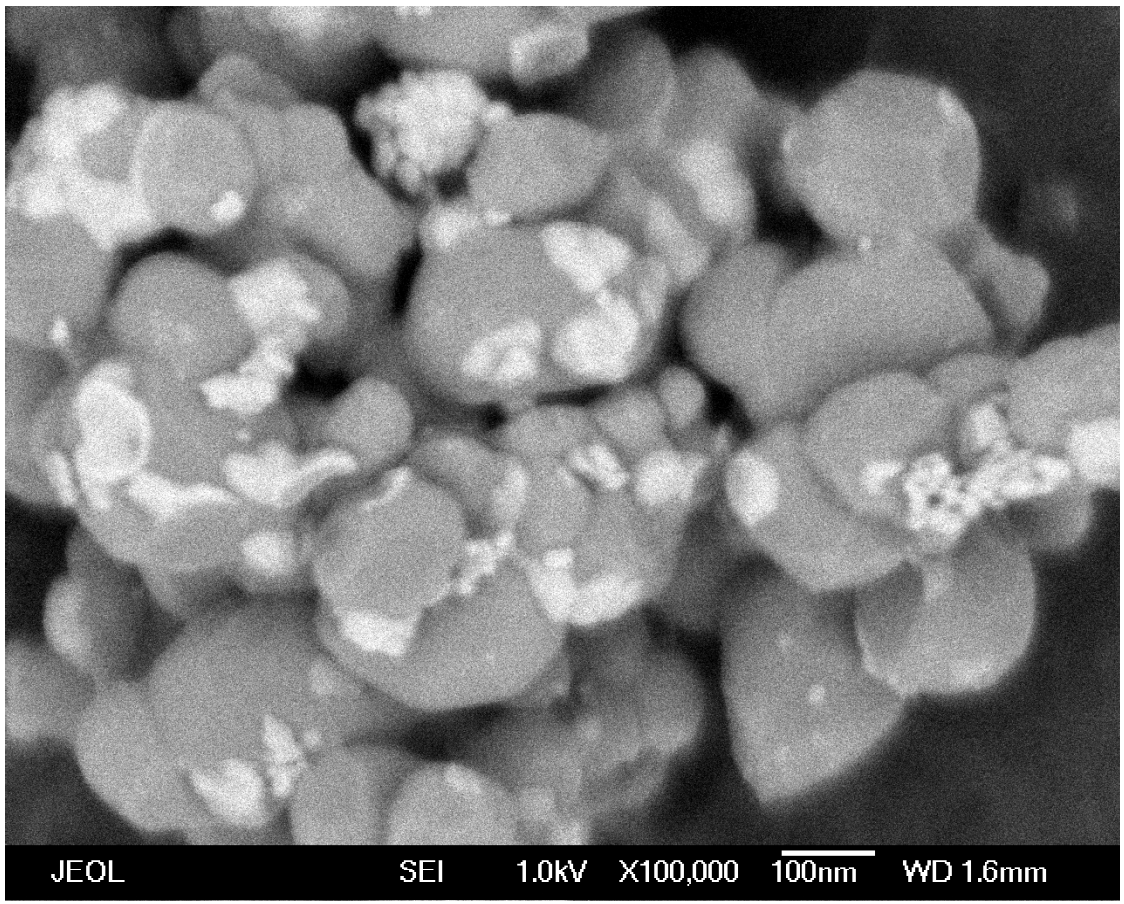

70
60
50
40
30
20
10
0
40 bar
20 bar
15 bar
10 bar
7 bar
0
50
100
160
200
250
315
400
500
Mikrometer

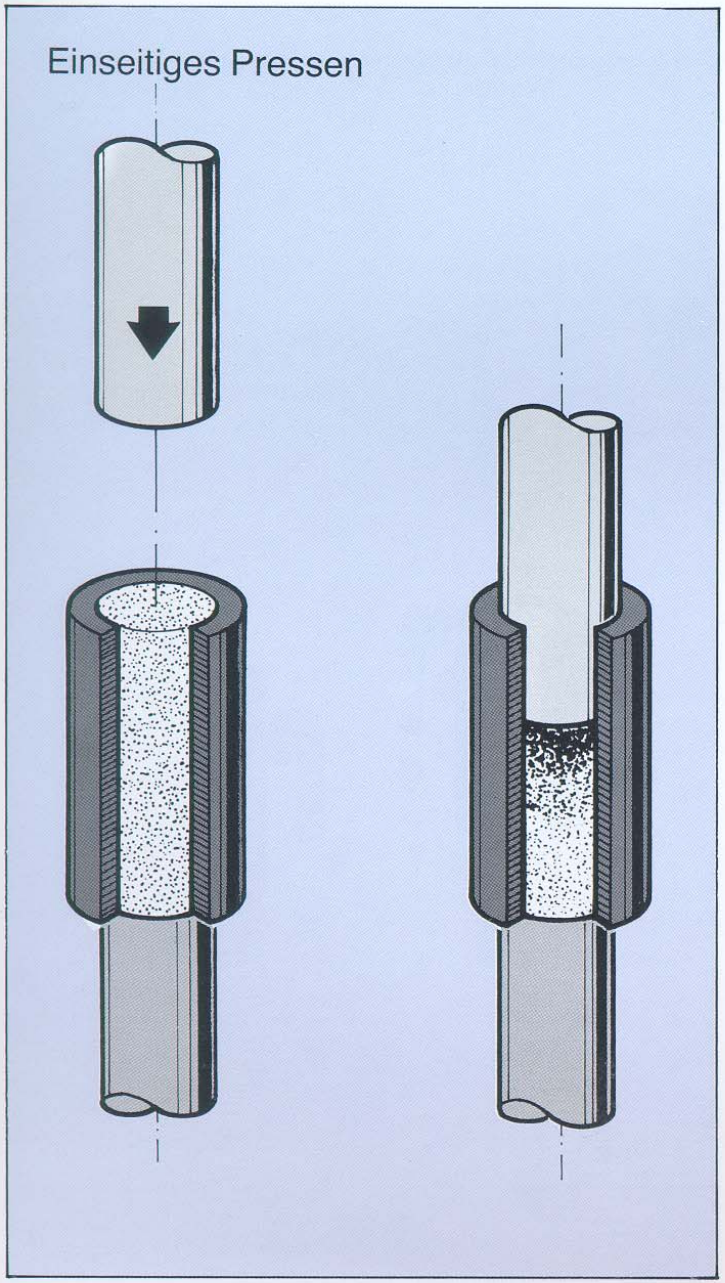

+SE 100 X 30KV 7174

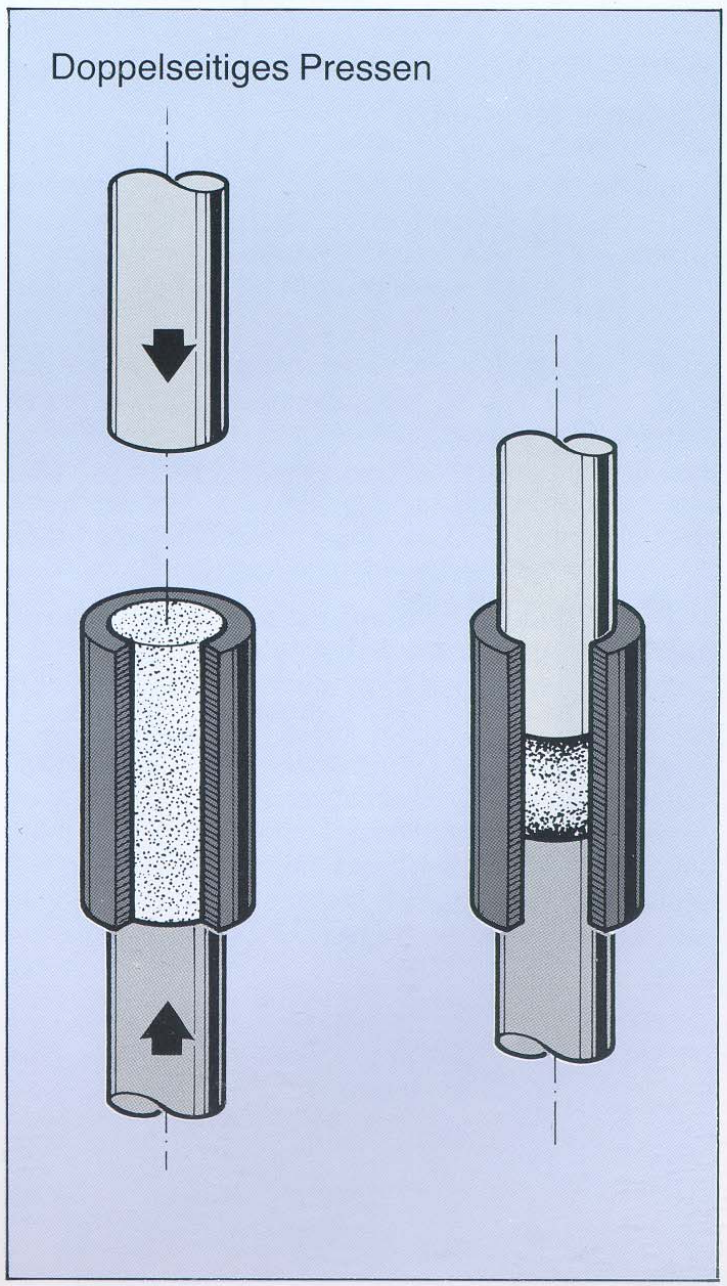

Tropfen
Anreicherung des Binders
Dampfdruck
Kragenbildung
Hohlraum
Temperaturzunahme


Abluftboube
Filterabreinigungs-
ventil
Startprodukt-
aufgabe
Filter
Abgabewehr
Zweistoffdüse
Fließbett
Zuluftverteiler
Siebboden
Gestell
Produkt-
abgabe
4540

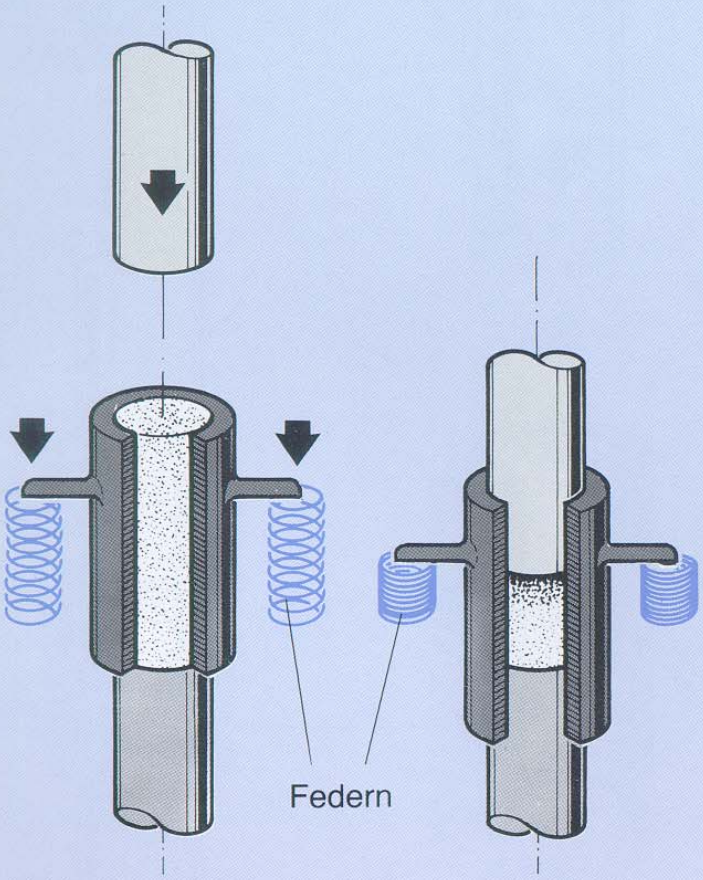
HR SEM of a nano sized Sb functionalised Surface




Einseitiges Pressen

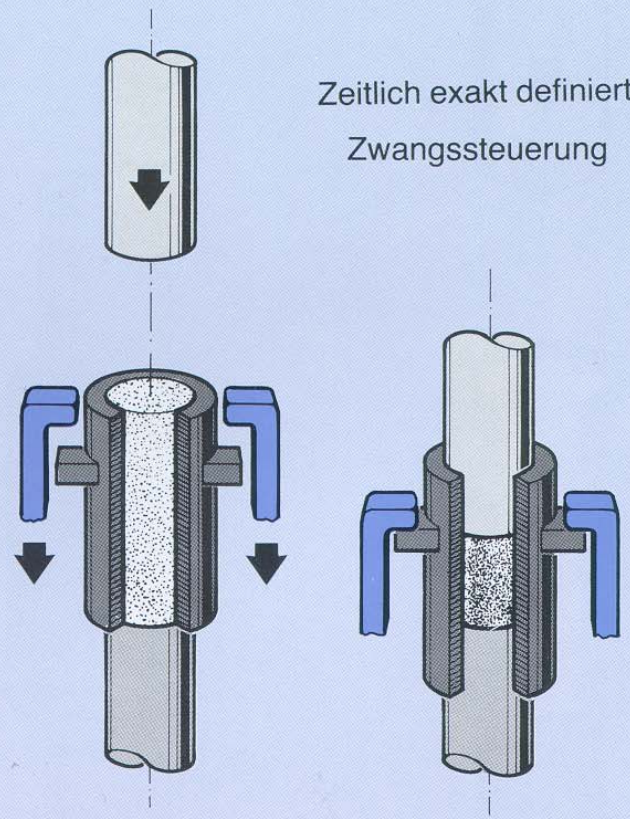

Doppelseitiges Pressen

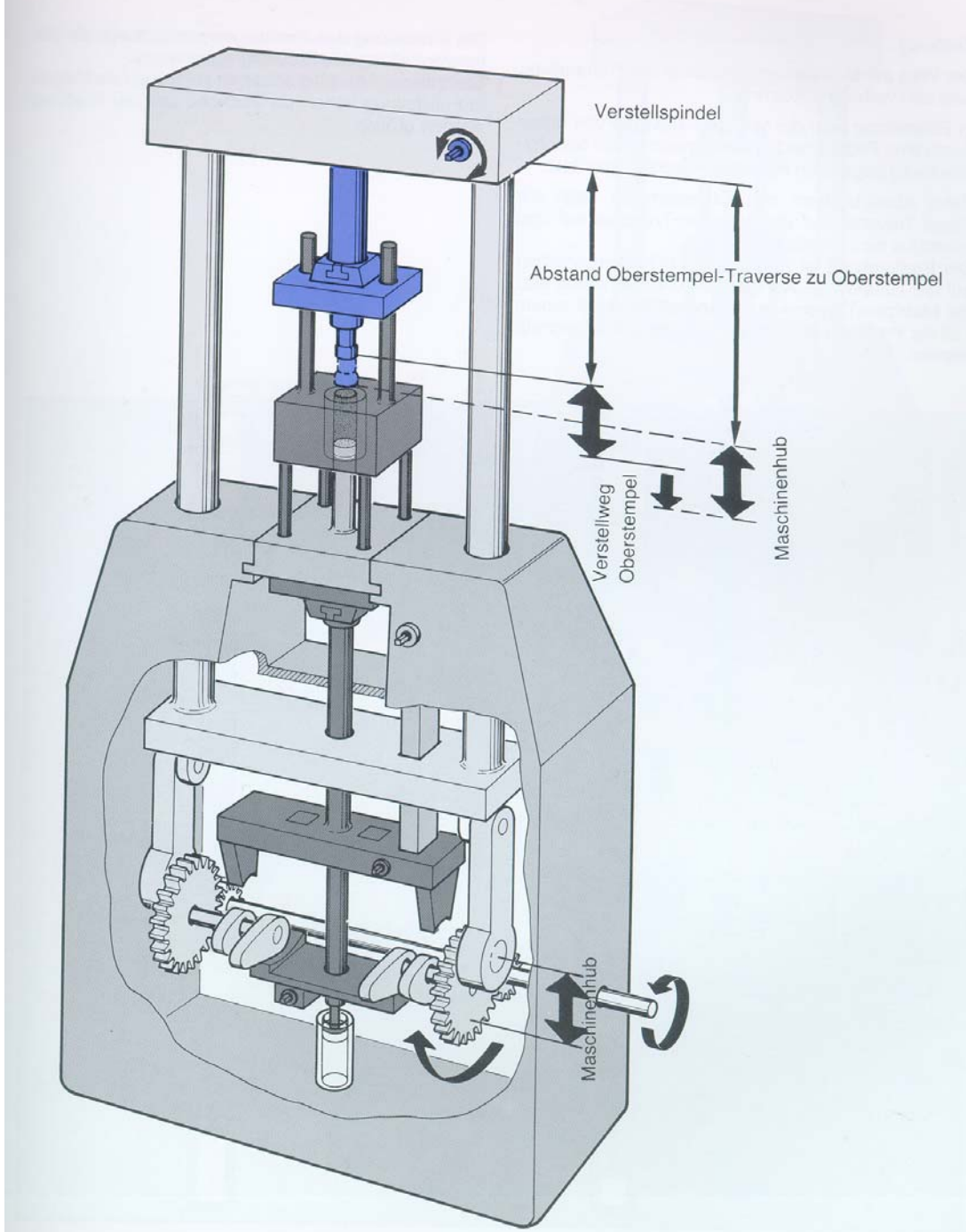
Pressen mit schwimmend gelagerter Matrize

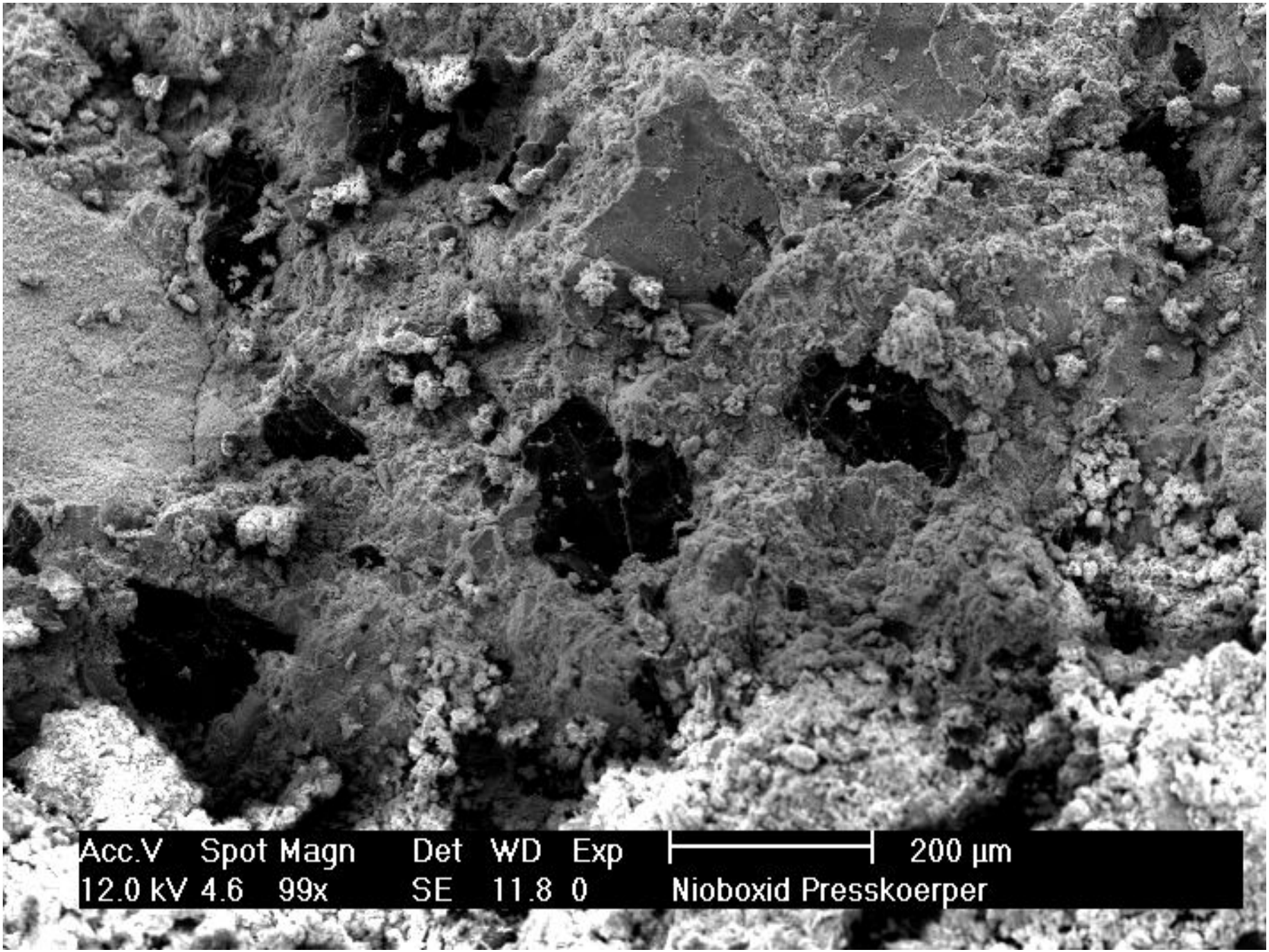


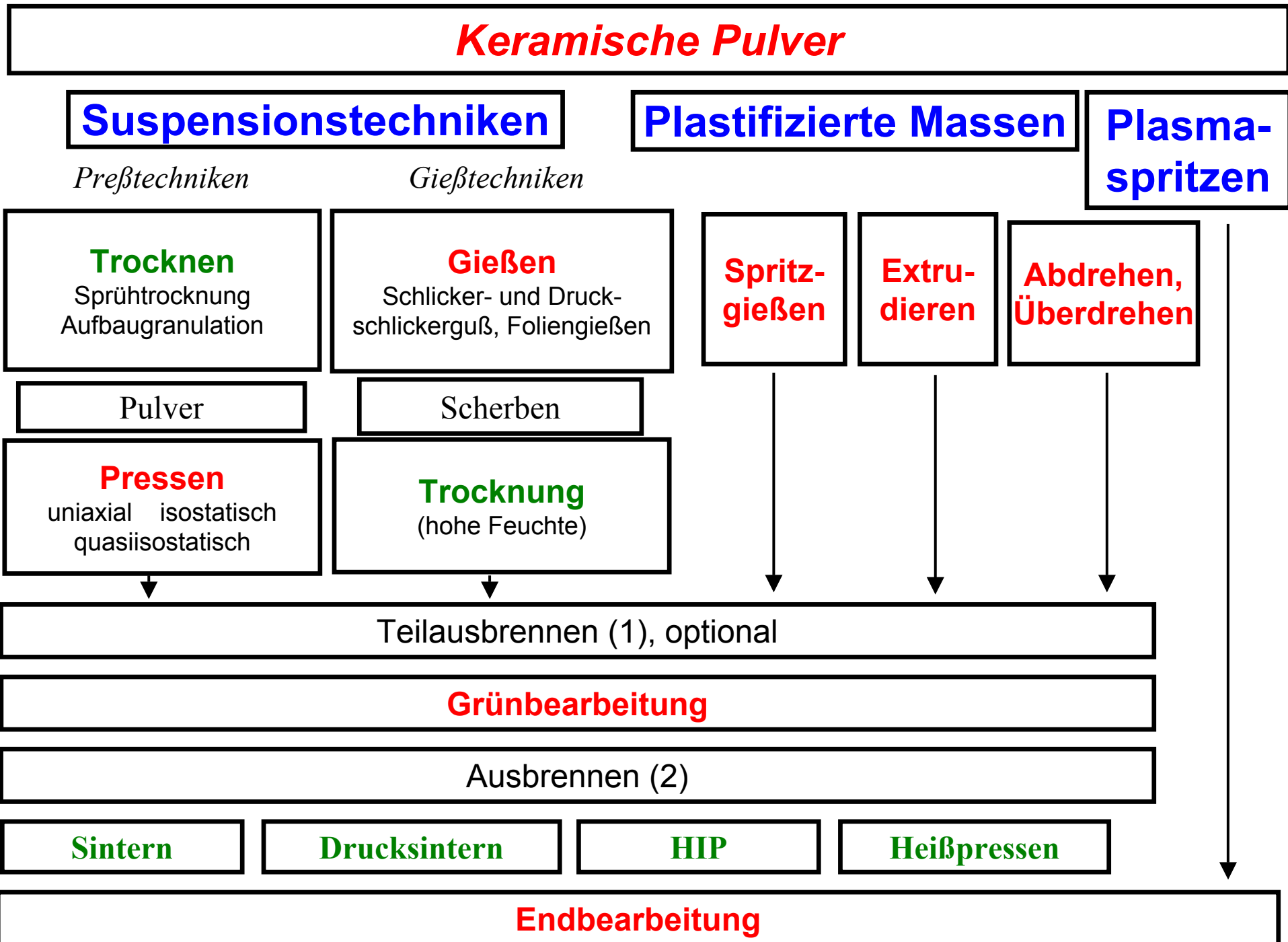
Pressen mit zwangsgesteuerter Matrize

Zeitlich exakt definierte Zwangssteuerung

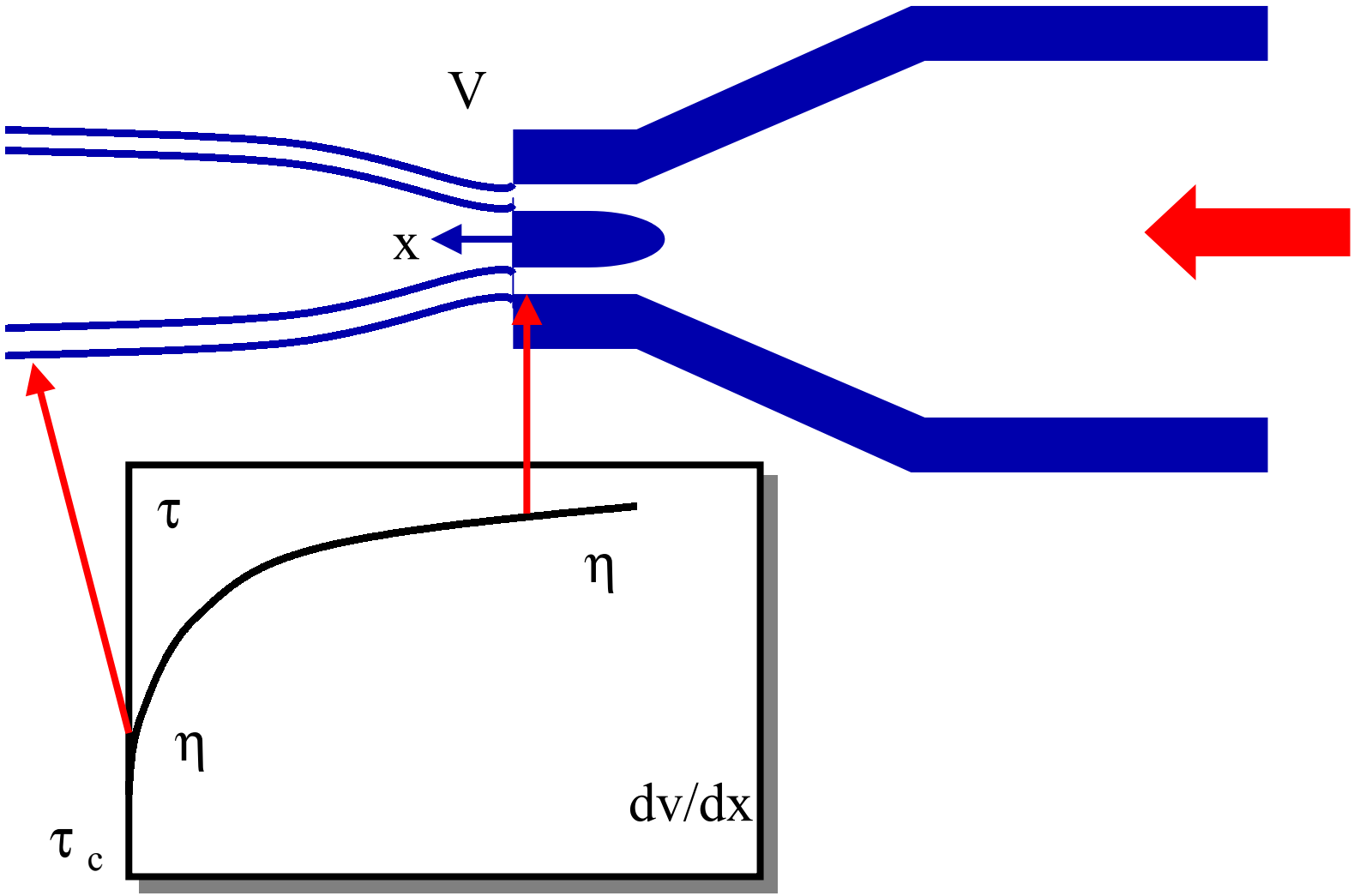



Verstellspindel
Abstand Oberstempel-Traverse zu Oberstempel
Verstellweg Oberstempel
Maschinenhub
Maschinenhub


Acc.V Spot Magn Det WD Exp
200 µm
12.0 kV 4.6 99x SE 11.8 0 Nioboxid Presskoerper

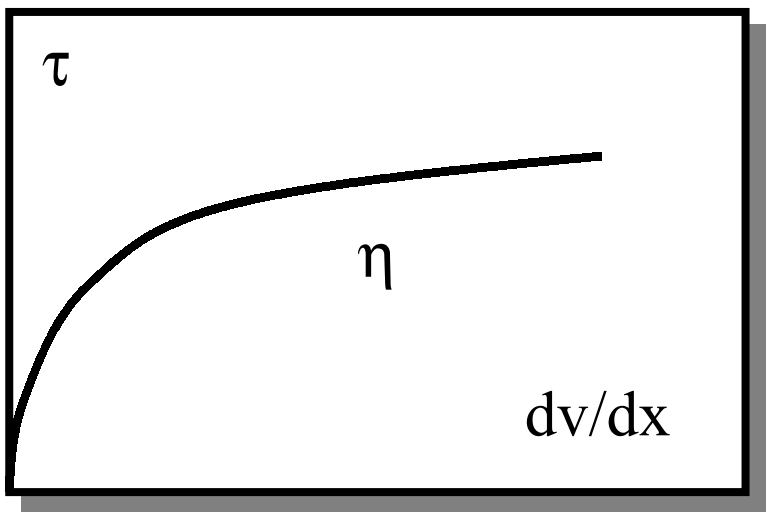

Keramische Pulver
Suspensionstechniken
Plastifizierte Massen
Plasma-spritzen
Preßtechniken
Gießtechniken
Trocknen
Sprühtrocknung
Aufbaugranulation
Gießen
Schlicker- und Druck-schlickerguß, Foliengießen
Spritz-gießen
Extru-dieren
Abdrehen, Überdrehen
Pulver
Scherben
Pressen
uniaxial isostatisch
quasiisostatisch
Trocknung
(hohe Feuchte)
Teilausbrennen (1), optional
Grünbearbeitung
Ausbrennen (2)
Sintern
Drucksintern
HIP
Heißpressen
Endbearbeitung

~ 50% Raw powder + ~20 Plasticiser + Solvent



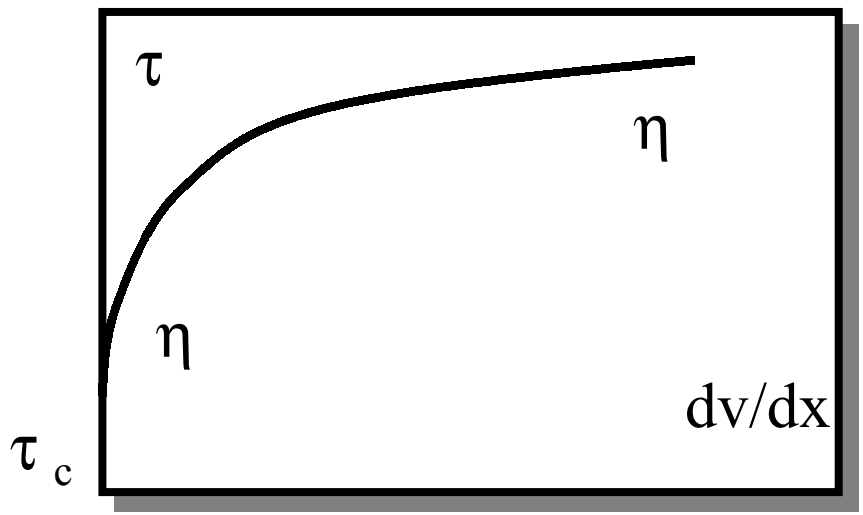
Structural Viscosity

$$\tau = a \left(dv/dx \right)^n$$

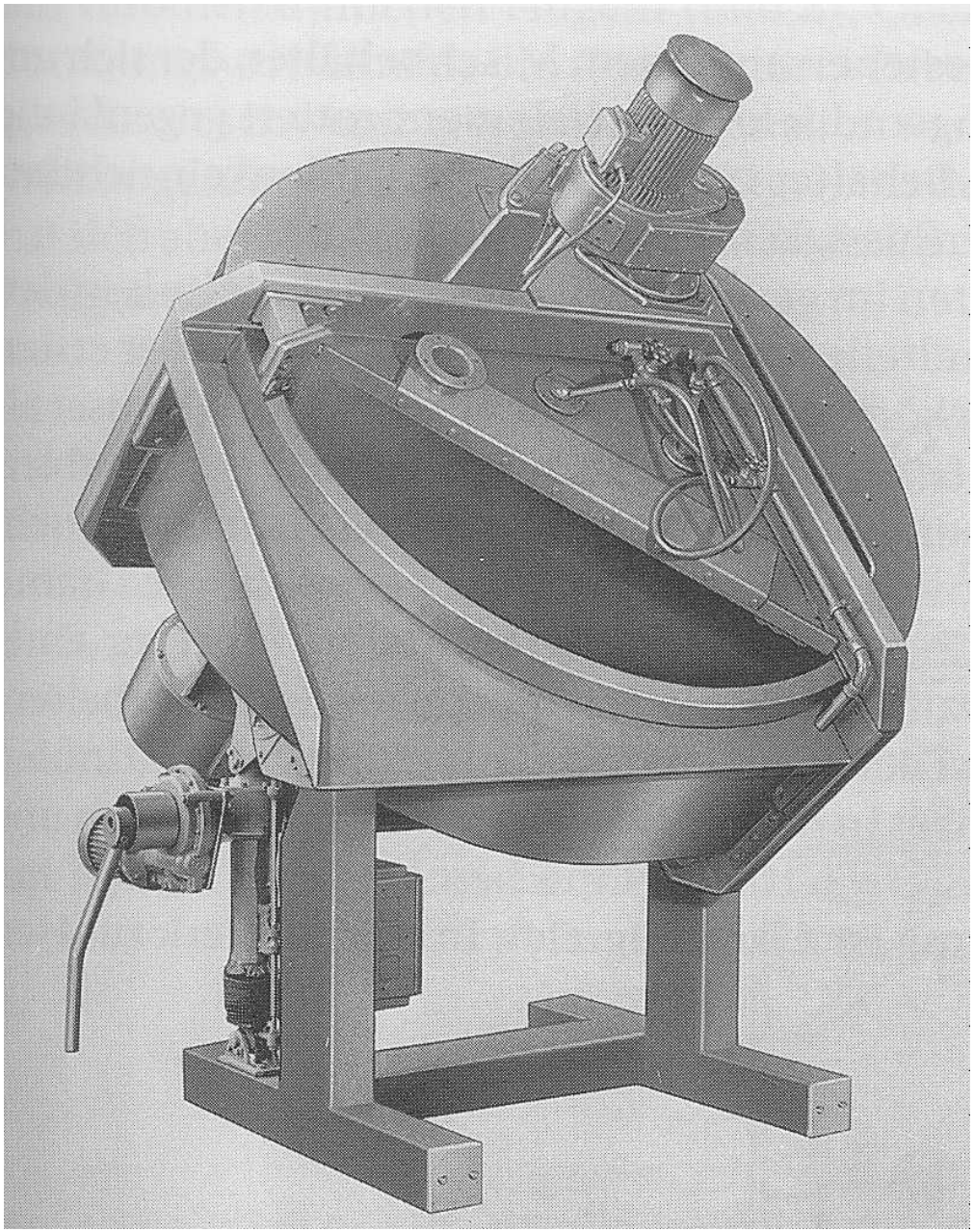


Herschel Bulkley

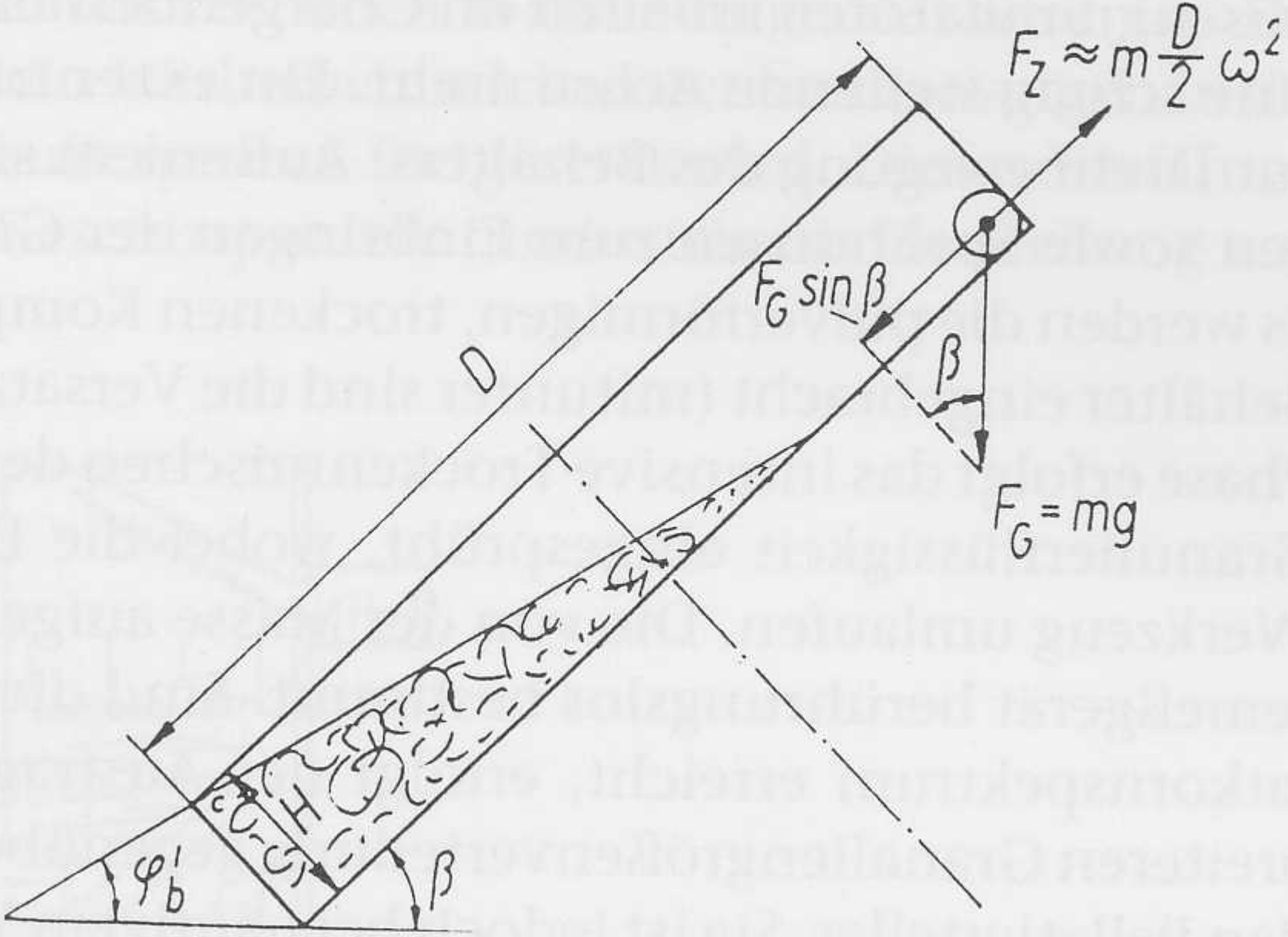
$$\tau = \tau c + a \left(dv/dx \right)^n$$

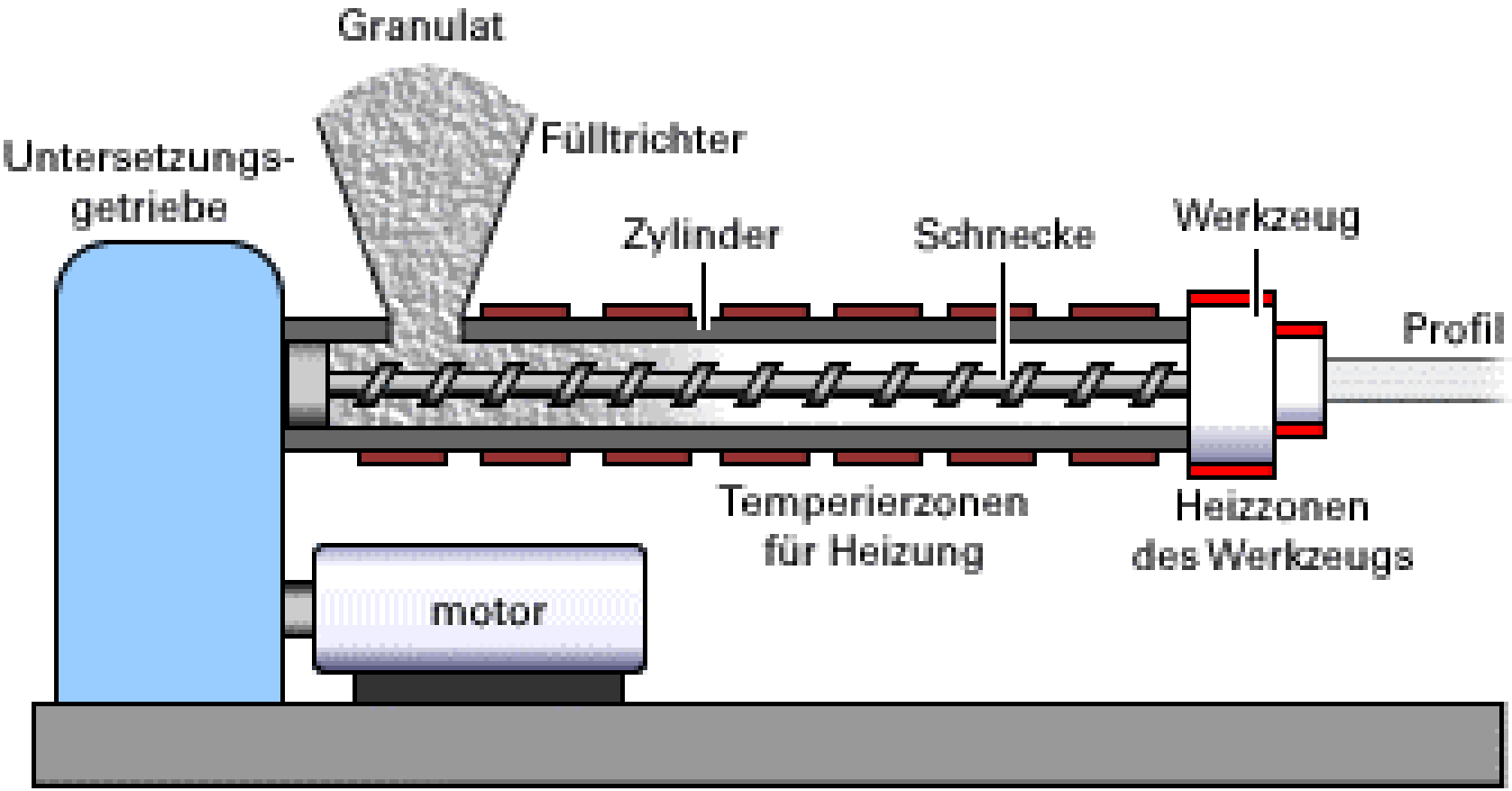


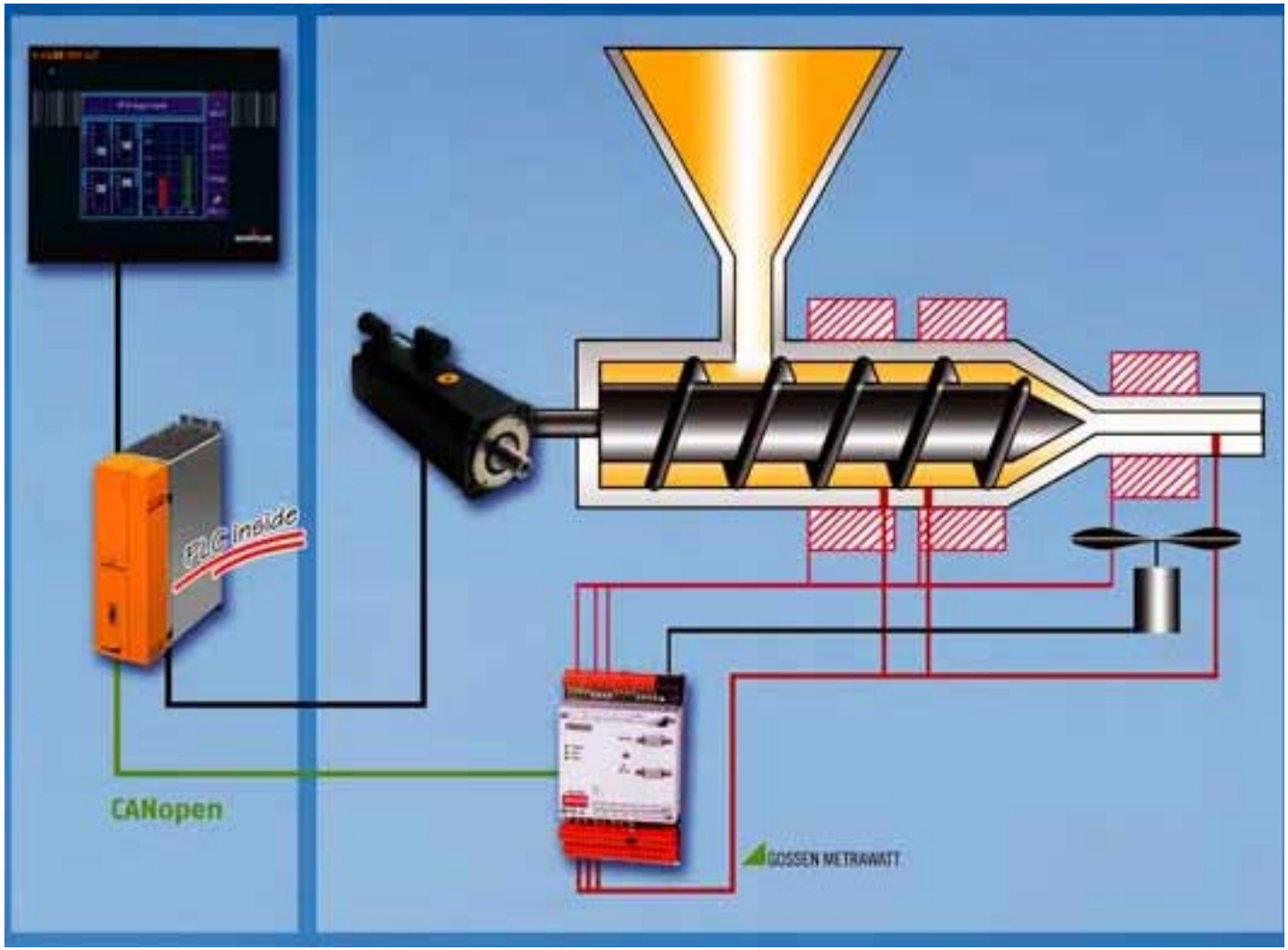
Yield stress, Schergrenze



Mixer


$F_Z \approx m \frac{D}{2} \omega^2$
$F_G \sin\beta$
β
D
$F_G = mg$
H
φ'_b
β


Granulat
Fülltrichter
Untersetzungs-
getriebe
Zylinder
Schnecke
Werkzeug
Profil
Temperierzonen
für Heizung
Heizzonen
des Werkzeugs
motor


PLC inside
CANopen
GOSSEN METRAWATT


WARNING