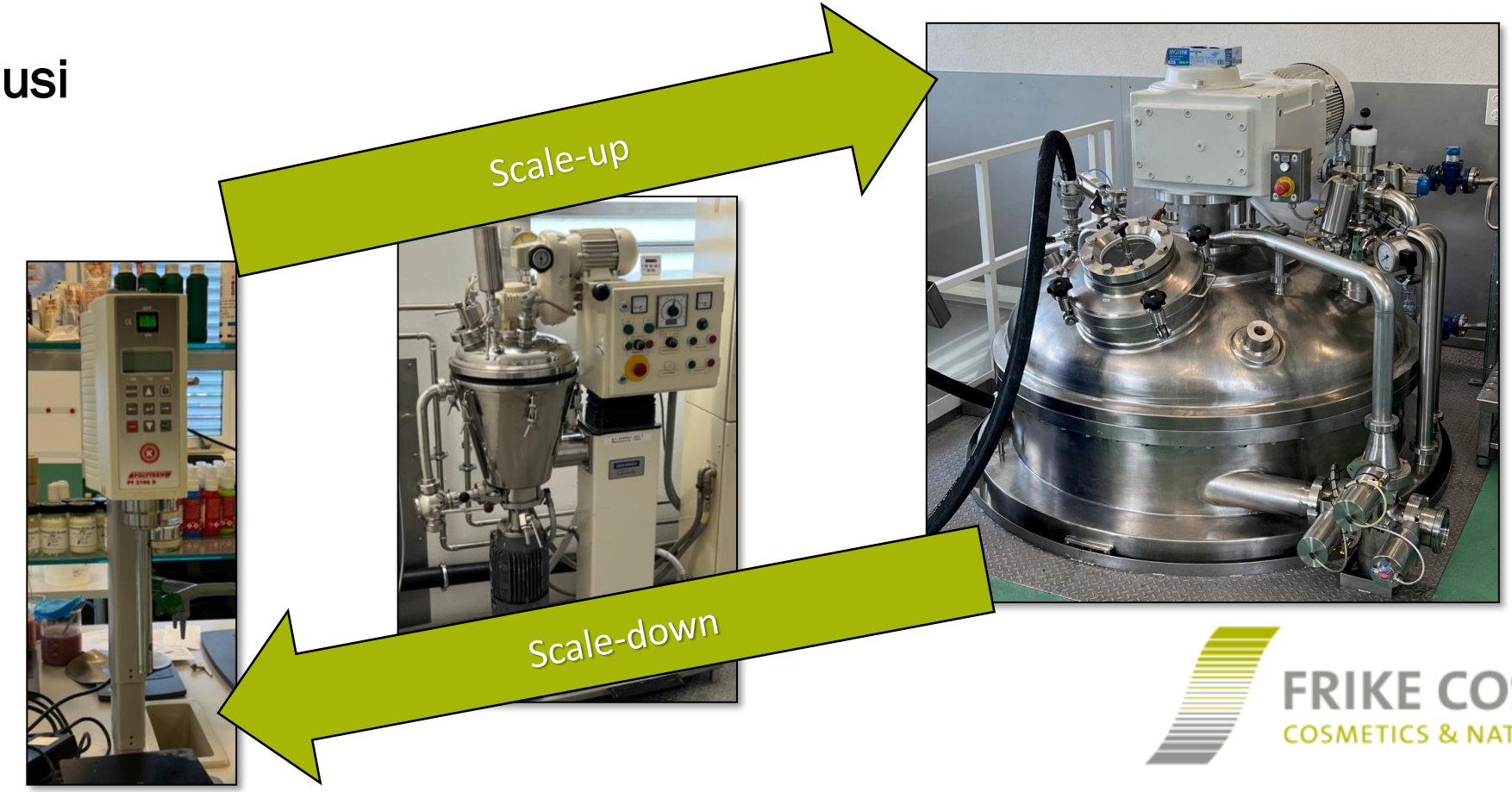
Process optimization through a more accurate scale-up and scale-down process

Yves Feusi



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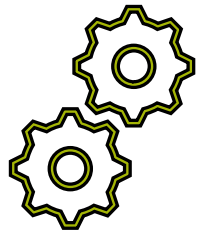
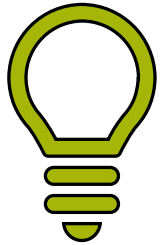
Company meets research project

Why did we join



How does it work in practices



What were our insights

HSLU Hochschule Luzern

FRIKE GROUP
A SMART SOLUTION

Zürcher Hochschule
für Angewandte Wissenschaften
zh
aw

Frike Company Goals

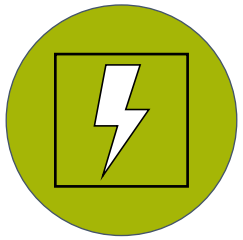
Reaching CO2 neutrality

Process control through KPI

Same product within scale-up

Faster processing

What is the added values for manufactures



RESOURCES

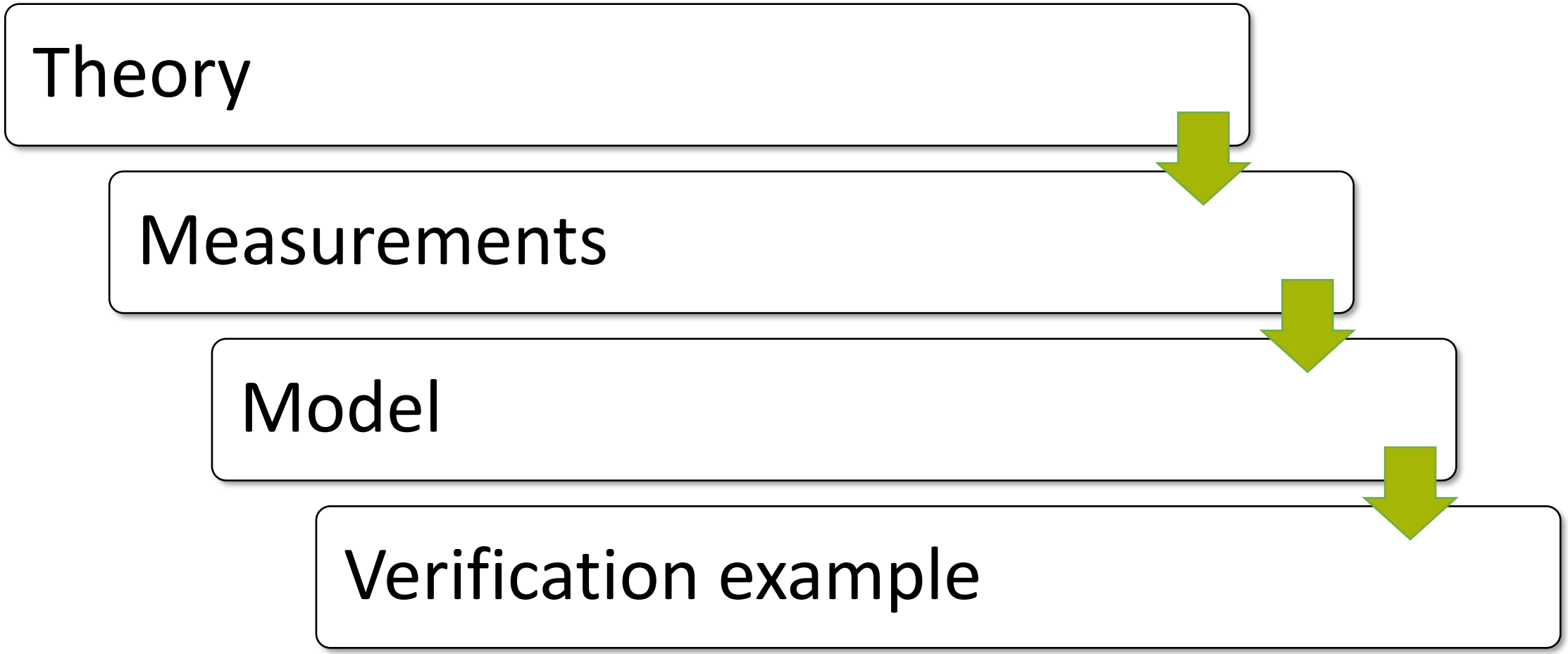
VARIETY OF FORMULAS

TIME PRESSURE

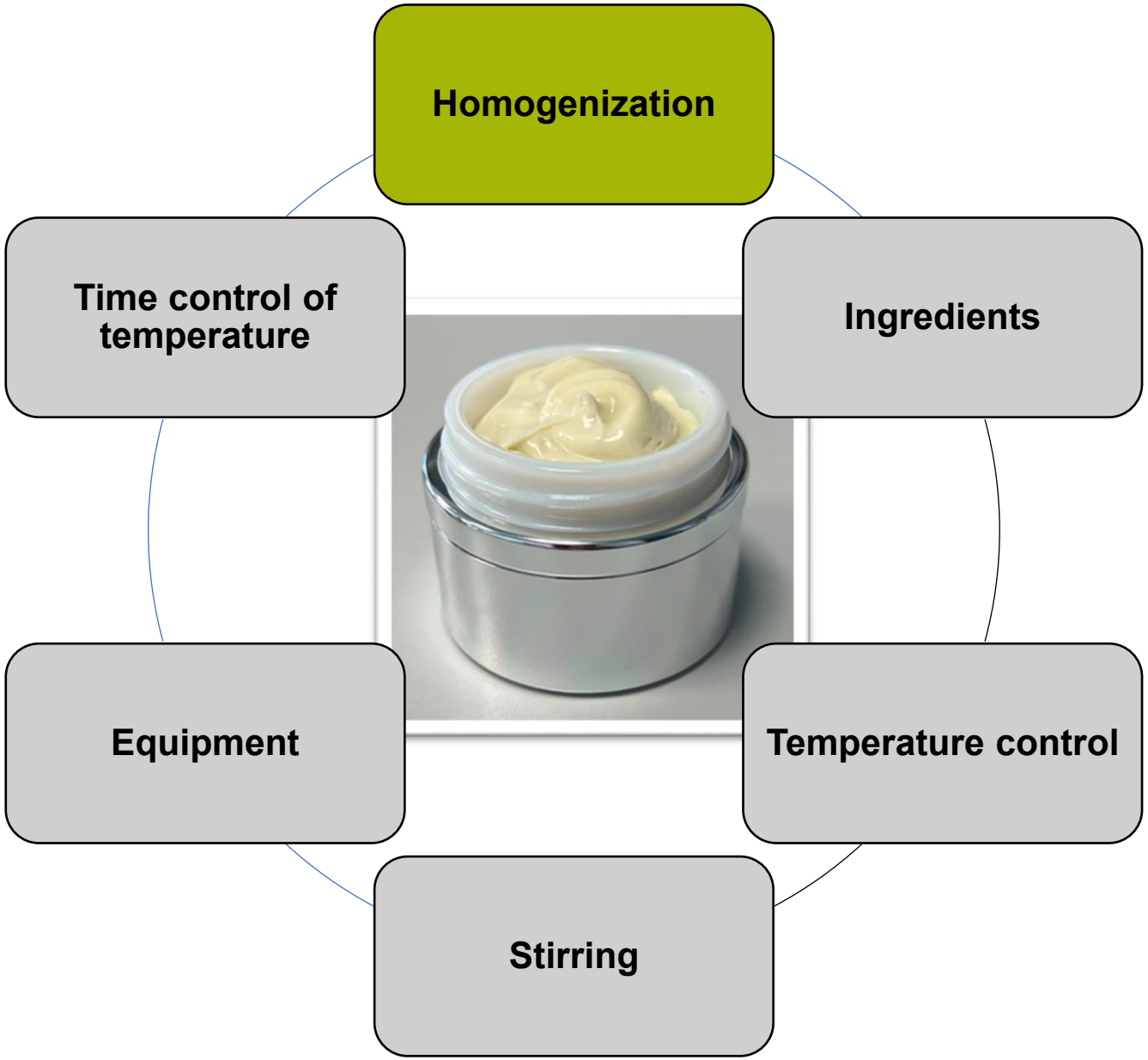
DEVIATING ORDER QUANTITIES

DIVERSE PLANT PARK

How does it work in practices



Influence Factors of a Cream



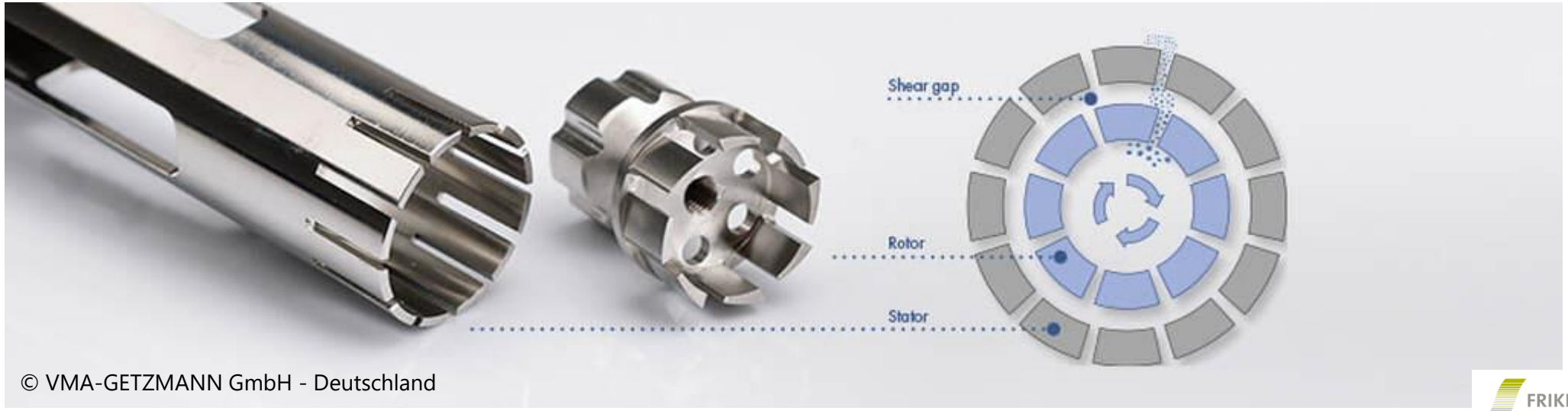
Theory (homogenization)

Shearrate

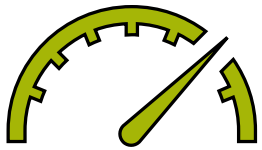
$$\dot{\gamma} = \frac{v(speed)}{\delta(gap/area)}$$

Specific Energy Input

$$E_M = \frac{P\ (Power)}{M\ (Mass)} \times \mathrm{t}$$

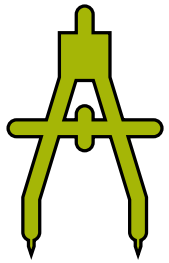


Measuring the process dimension



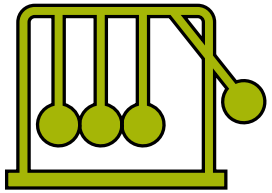
range of capacity

Minimum and maximum of Volume and RPM



Dimensions of the homogenistor

Diameter of rotor and stator



Energy input

Energy input of the homogeniser into the product

Range of Capacity

Process machine

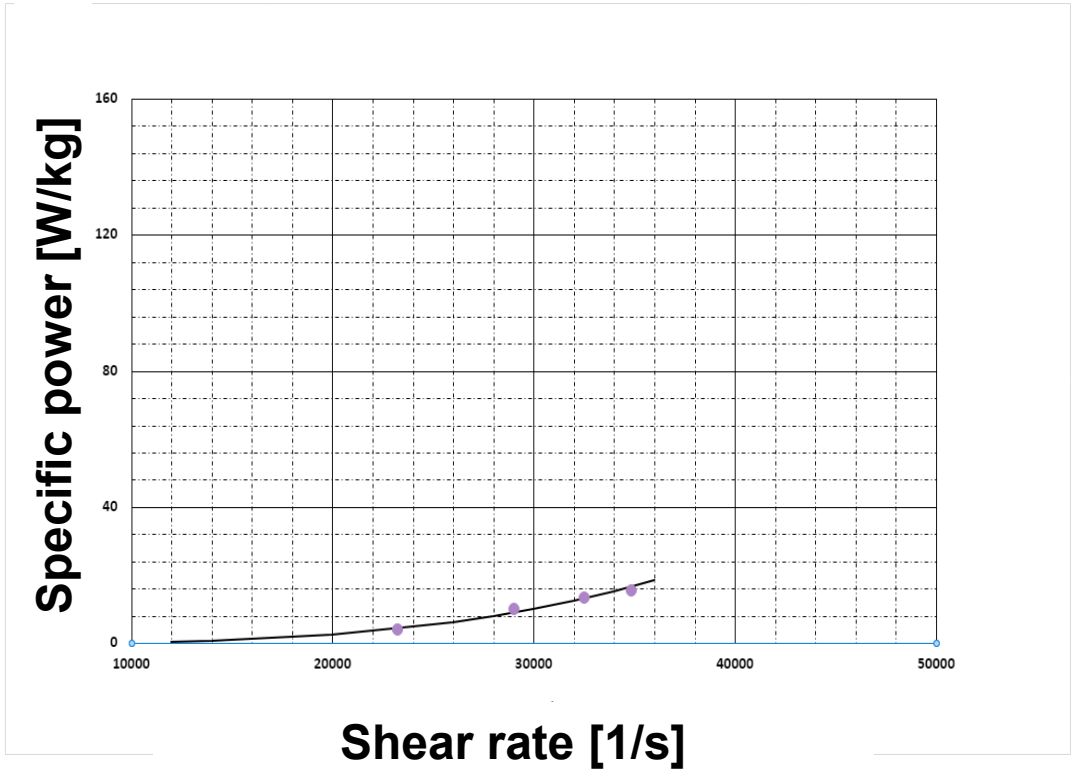
Volume: 500 – 1500 l
Range: 500 – 3000 rpm
Homogenizerdiameter: 168 mm
Homogenizer Gap: 0.75 mm

Lab homogenizer

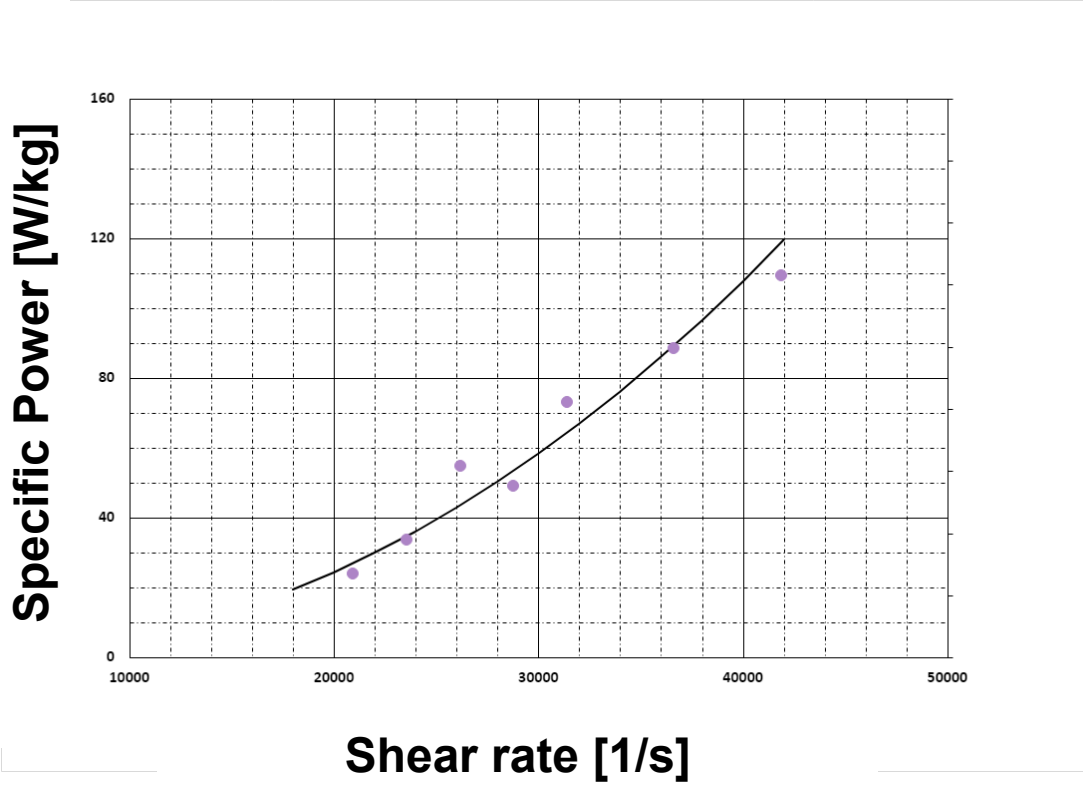
Volume: 0.3 – 1.5 l
Range: 1000 – 24000 rpm
Homogenizer Diameter: 15.6 mm
Homogenizer Gap: 0.3 mm

Measurements of energy input

Process machine



Lab homogenizer



Homogenization Model

Down-scale

Model

Up-scale

Hypothesis:
Identical Shearrate +
Identical Energy rate
= <u>Identical Product</u>

Example

800 kg
2000 rpm
300 s

10 kg
5200 rpm
30 s

0.3 kg
8800 rpm
48 s

0.5 kg
13000 rpm
200s

12 kg
7800 rpm
56 s

1000 kg
3000 rpm
600 s

Verification

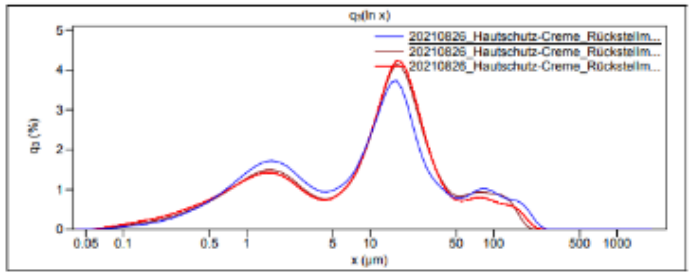
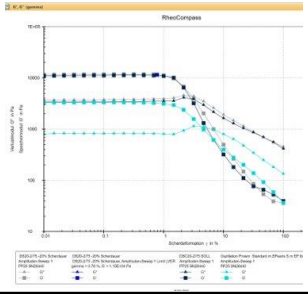
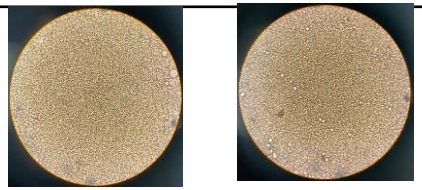
- Down- Scale
- OW- Emulsion
- Rich in fatty acids

Batchsize: 1200 kg
Rpm: 2000
Time[s]: 300

Down-scale

Batchsize: 0.5 kg
Rpm: 8070
Time[s]: 48

Results

Dropplet seperation		✓
Viscoelastic point		✓
Stability	Stable over 3 months at 40°C	✓
Microscope		✓
Viscocity/Sensory Panel	Viscocity was different/ Significant different (p=0.05%)	−

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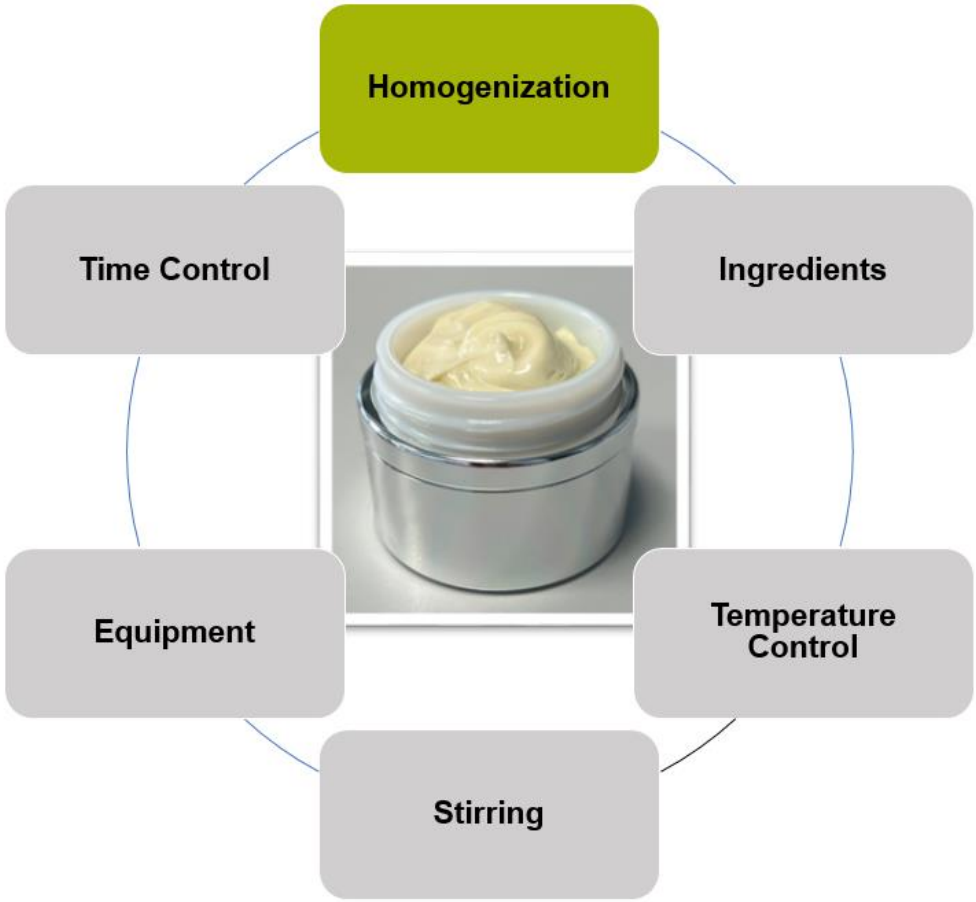
But...

Not every cream is the same!

It is a <u>simplyfied model</u>



But the model works for the homogenization step!

Is it Worth?

Time Consuming

Increased security

On the way to CO2 Neutrality

Know-how

Definitely!

Thank you

For more questions, please contact:

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Petra Huber, ZHAW University of applied science
(Energieeffiziente Kosmetikherstellung, ein Leitfaden mit 6 Effizienzkonzepten (2023, in progress), DOI)

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