

Optische und messtechnische Visualisierung von Verstopfungseignissen bei Abwasserpumpen



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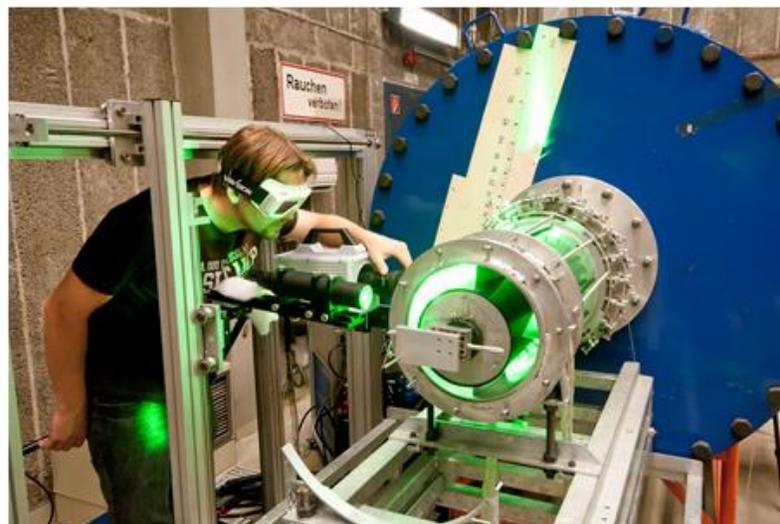


Lehre:

Strömungsmechanik,
Strömungsmaschinen,
Windenergieanlagen,
etc.

Forschung:

Pumpen und Systeme,
Strömungsmesstechnik,
Wasser & Abwasser,
Digitalisierung,
etc.



Verstopfungen in Abwasserpumpen



Motivation – Verstopfungen in Abwasserpumpen



Motivation – Verstopfungen in Abwasserpumpen



Untersuchung der Verstopfungsphänomene im Labor



Untersuchung von Abwasserpumpen + Pumpstationen



Pumpstation



Reales Pumpwerk



Funktionsprüfstand



Abwasserpumpen

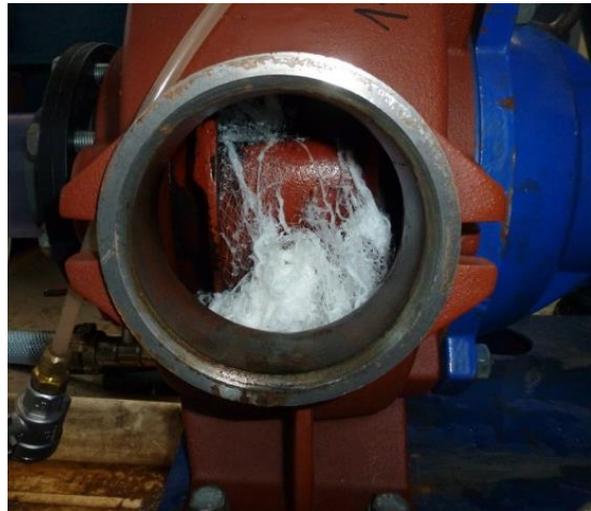


Schachtpumpen

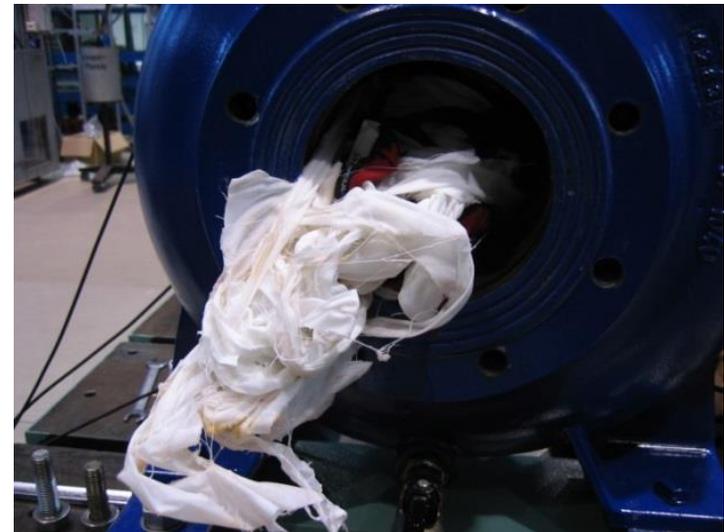
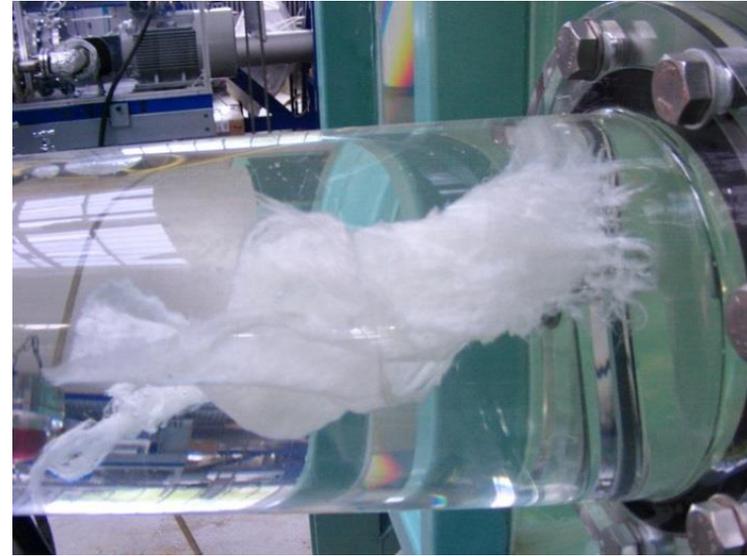


Digitaler Zwilling

Verstopfungen in Abwasserpumpen – im Labor



Verstopfungen in Abwasserpumpen – im Labor



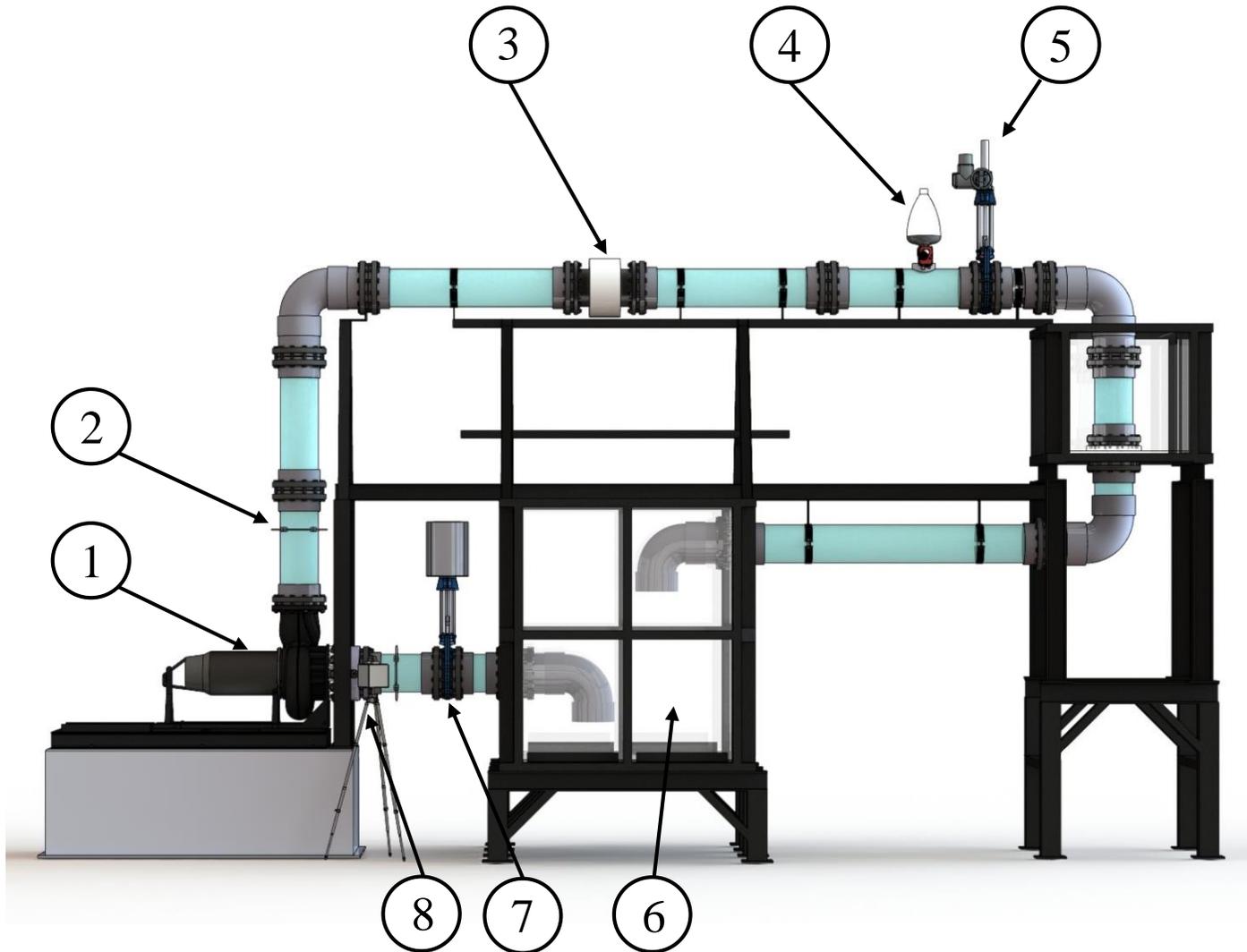
Visualisierung der Interaktion Laufrad / Textil



Versuchstand einer kompletten Pumpstation

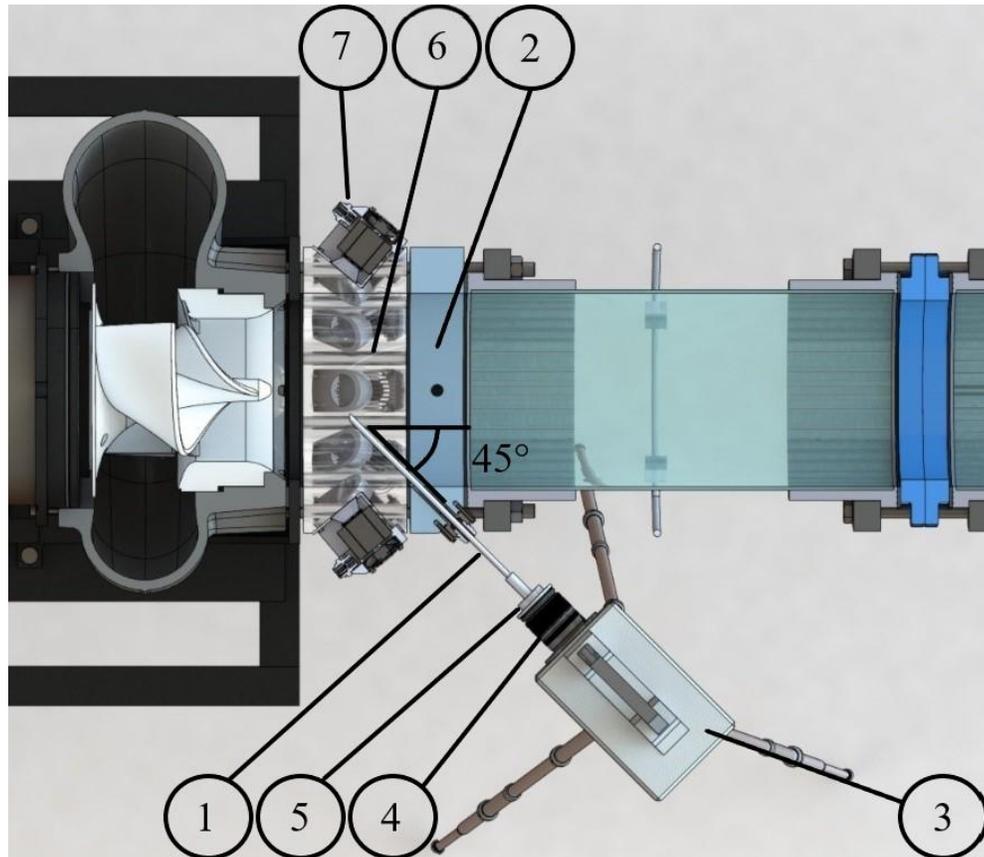


Versuchsstand einer kompletten Pumpstation

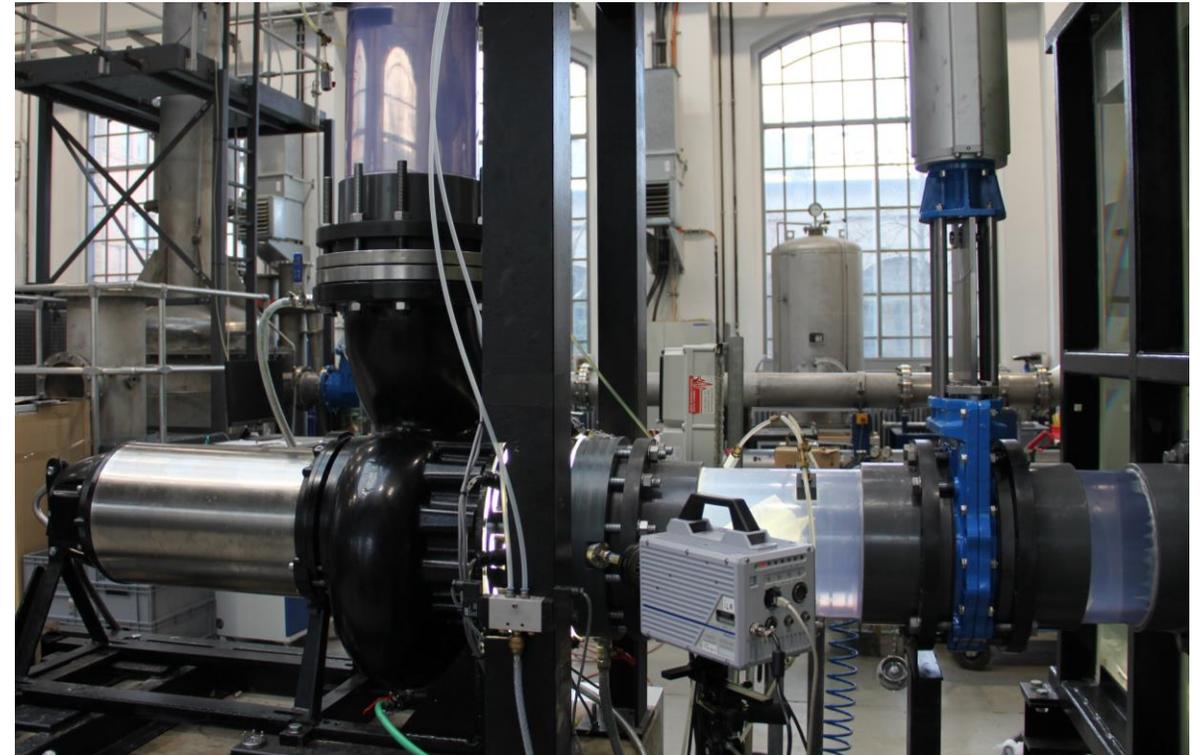


- 1) Abwasserpumpe DN250
- 2) Druckmessung
- 3) Volumenstrommessung MID
- 4) Entlüftung
- 5) Schieber
- 6) Saugraum 6m³
- 7) Schieber
- 8) Optischer Zugang

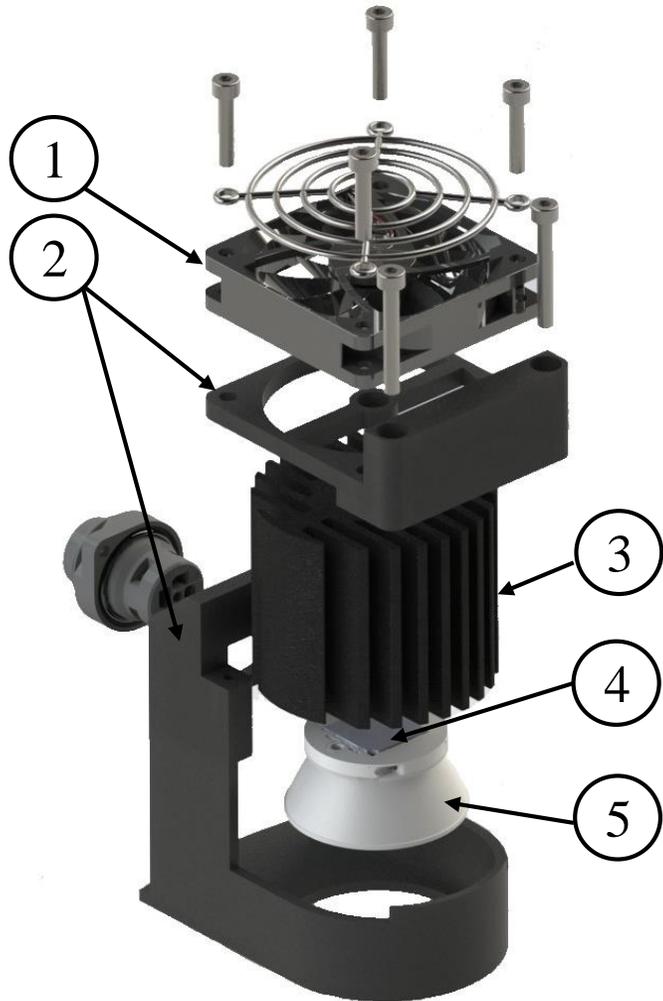
Optischer Zugang



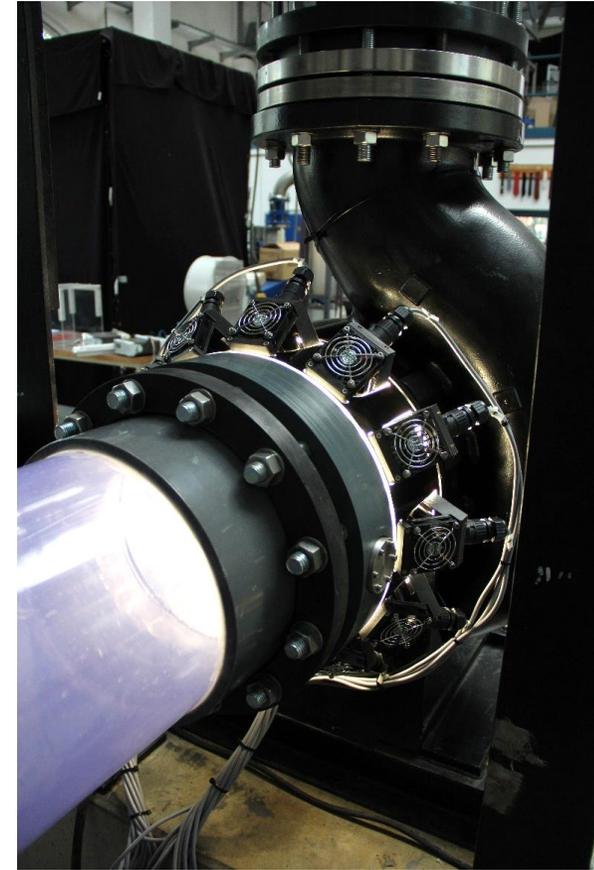
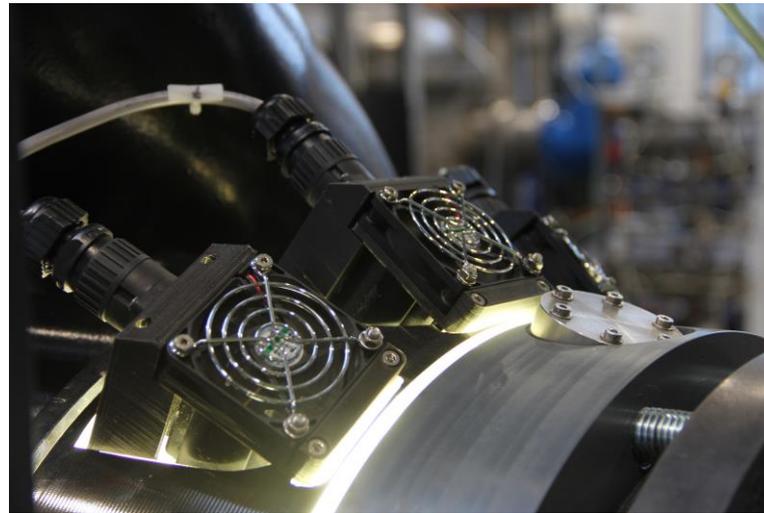
- 1) Endoskop
- 2) Endoskop-Flansch
- 3) High-Speed Kamera (2.000 fps)
- 4) Objektiv
- 5) Adapter
- 6) Lichtring-Flansch
- 7) LED – Lampe



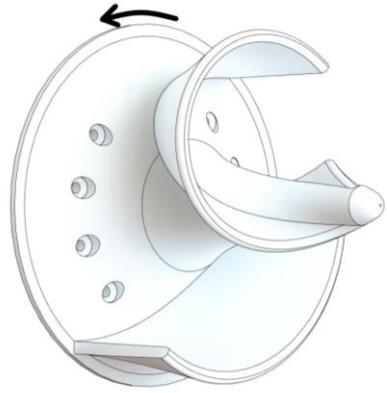
Optischer Zugang



- 1) Gebläse
- 2) Gehäuse, 3D Druck (PLA)
- 3) Aluminum Kühlrippen
- 4) Chip – LED (5560 lm, 12 Stk.)
- 5) Reflektor

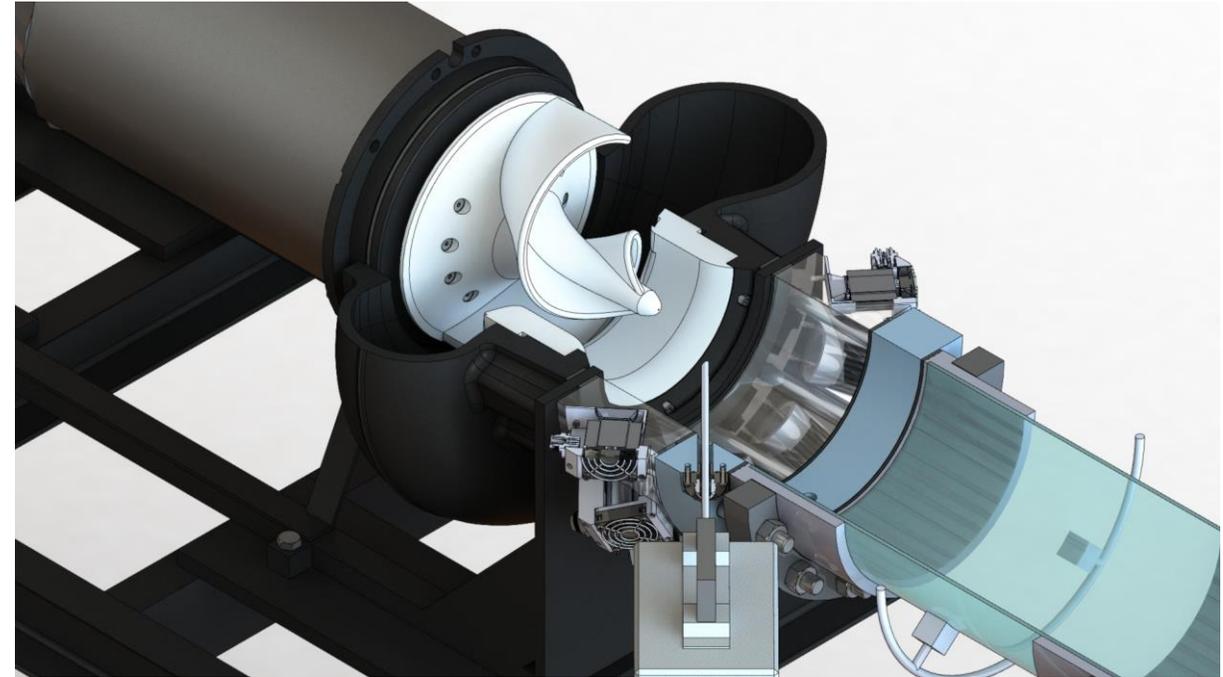
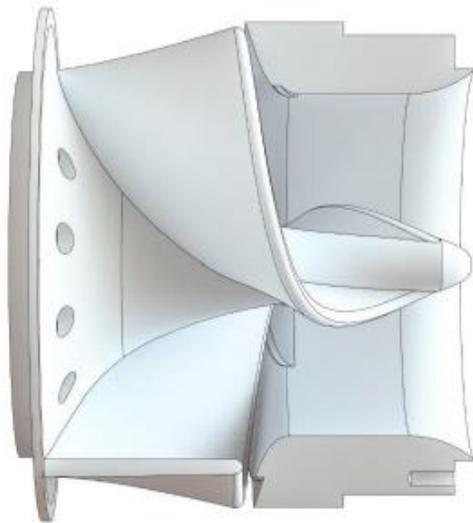


Lauftrad



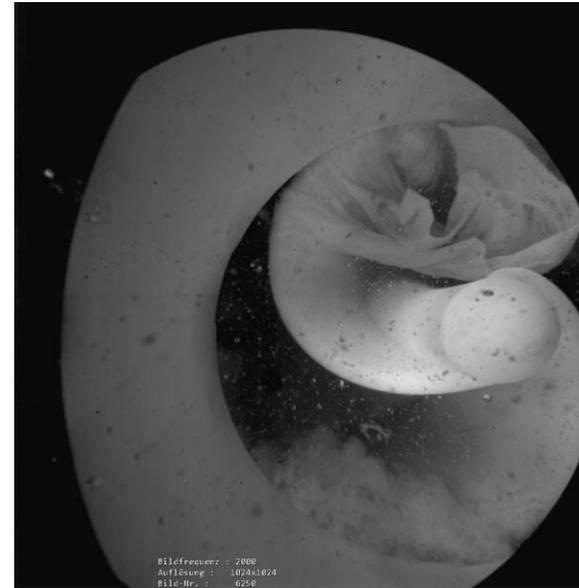
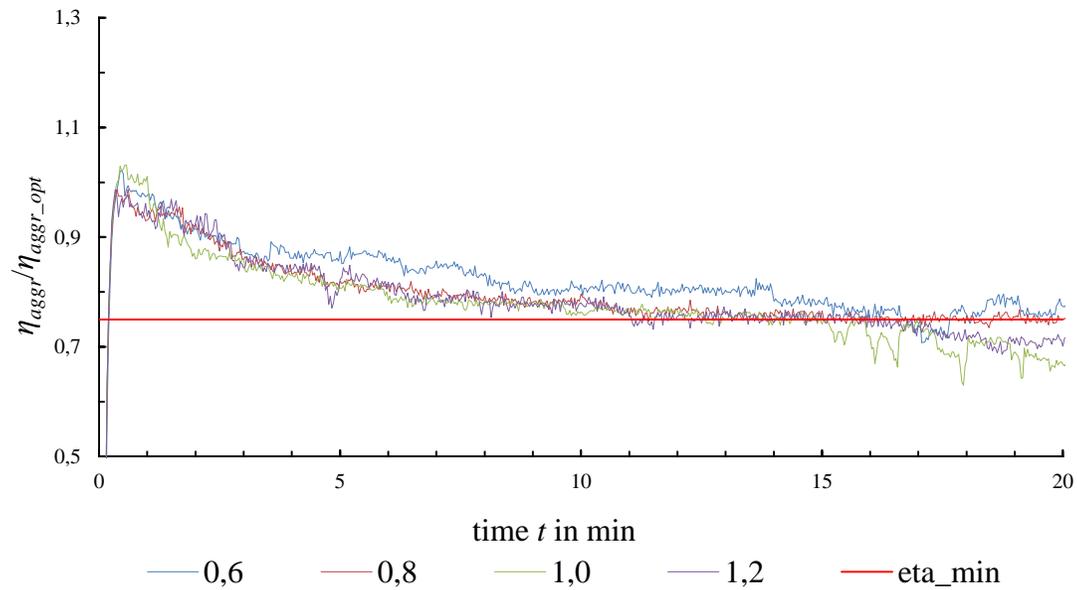
- Lauftrad:
 - Schraubenförmig
 - Durchmesser: 300 mm

- Schleißring:
 - Spaltweite 1 mm
 - 3 Nuten

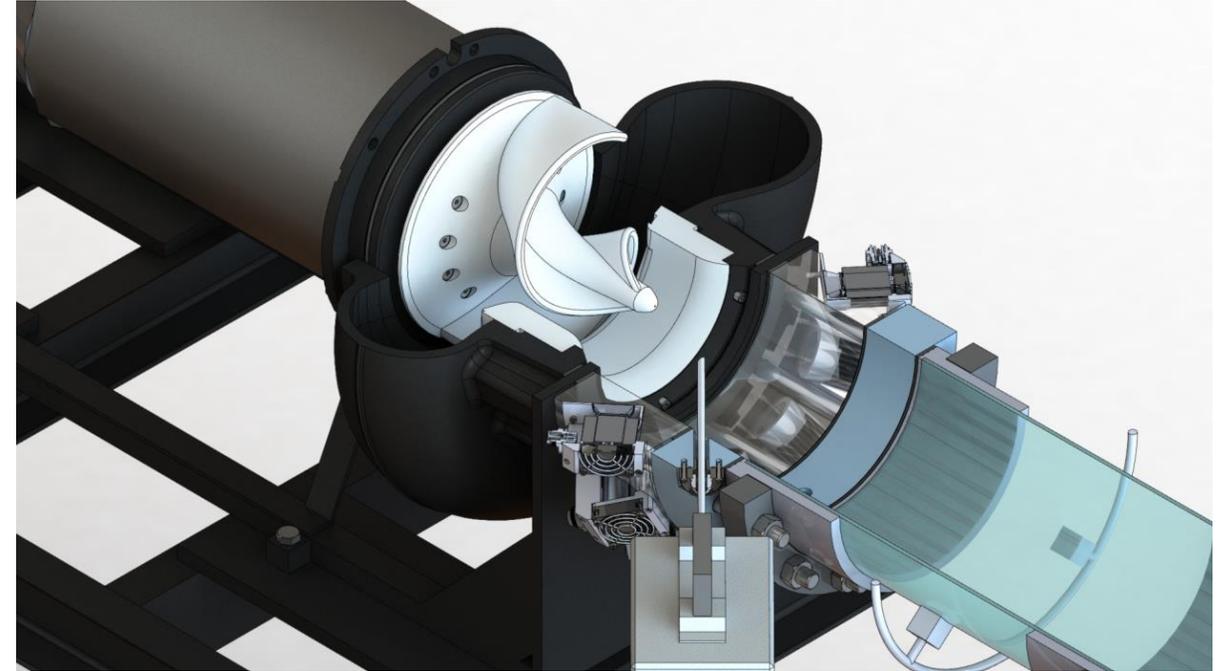
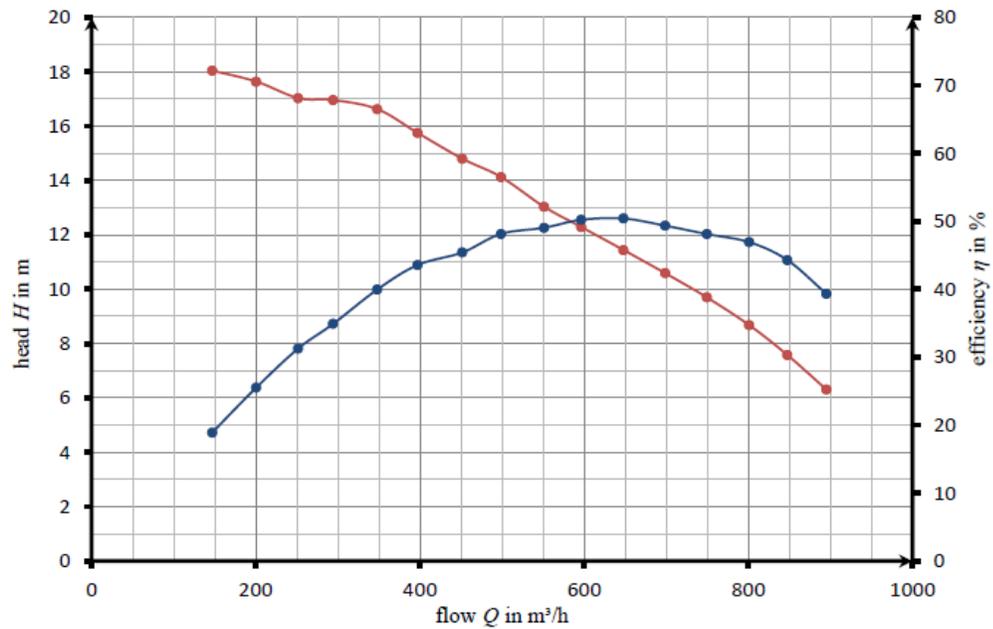
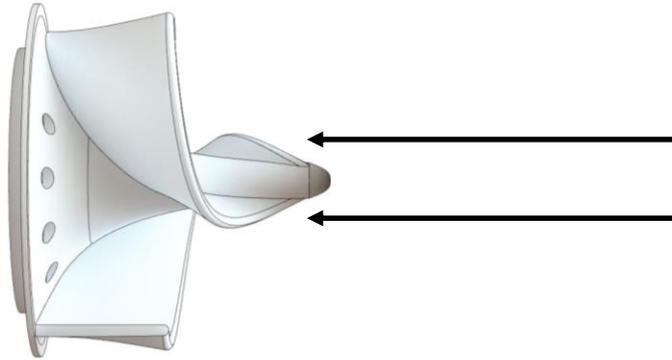


Messprogramm

load in textiles/m ³	operation points			
	$Q/Q_{BEP} = 0.6$	$Q/Q_{BEP} = 0.8$	$Q/Q_{BEP} = 1.0$	$Q/Q_{BEP} = 1.2$
25				
50				
100				



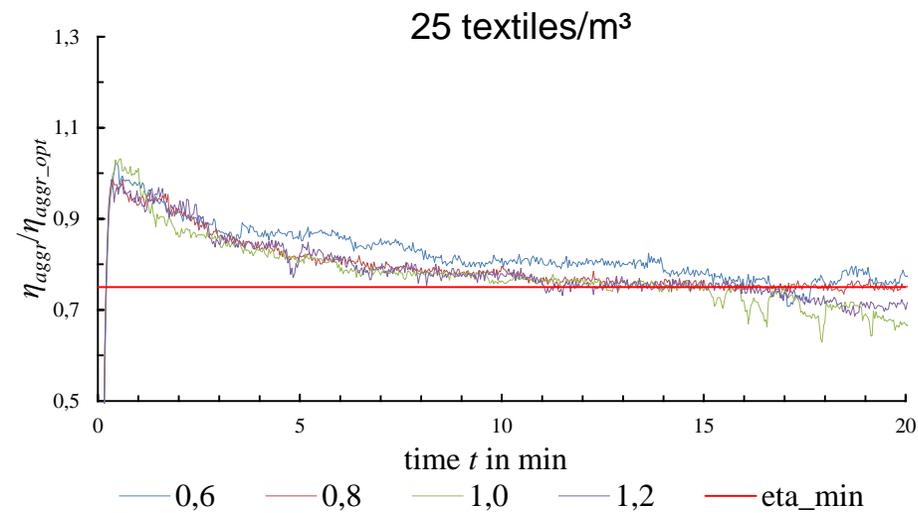
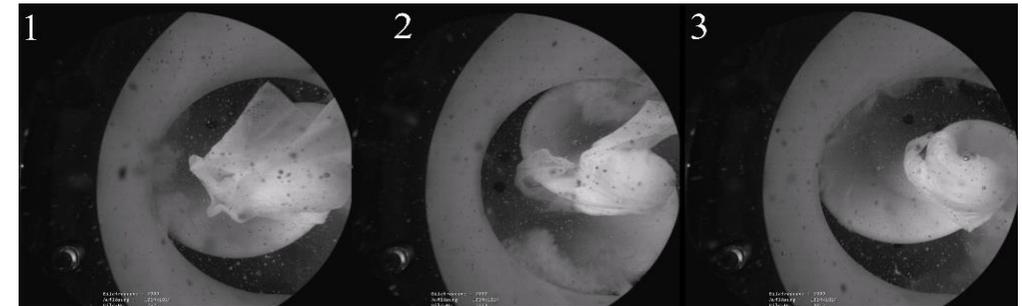
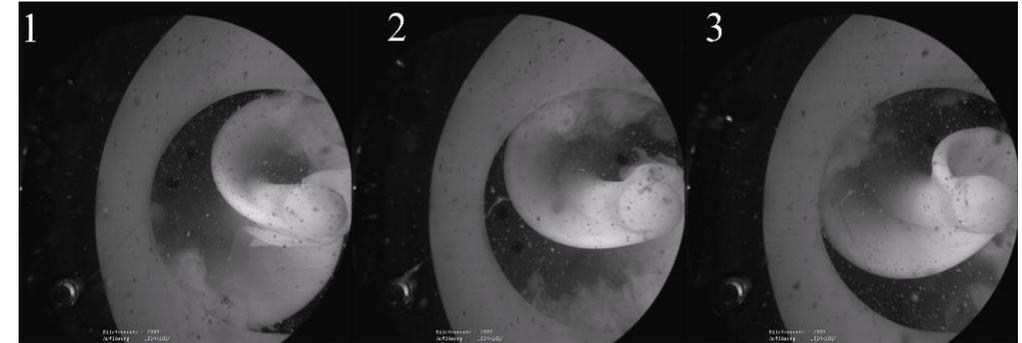
Konfiguration 1



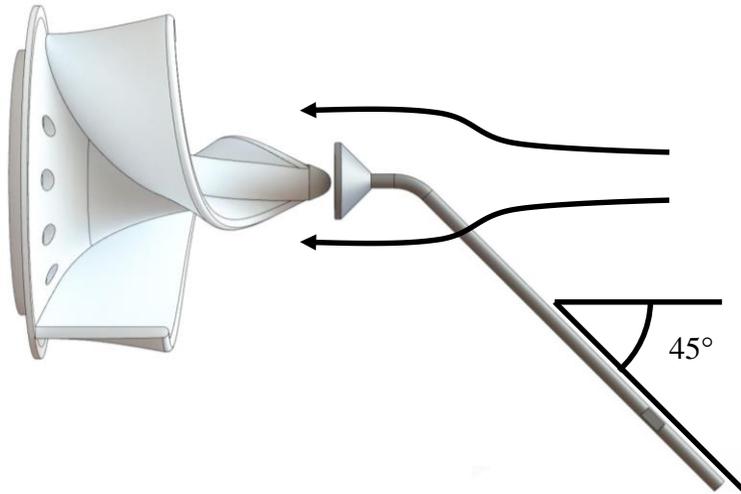
Ergebnisse Konfiguration 1

$Q/Q_{BEP} = 1.0$, 25 textiles/m³

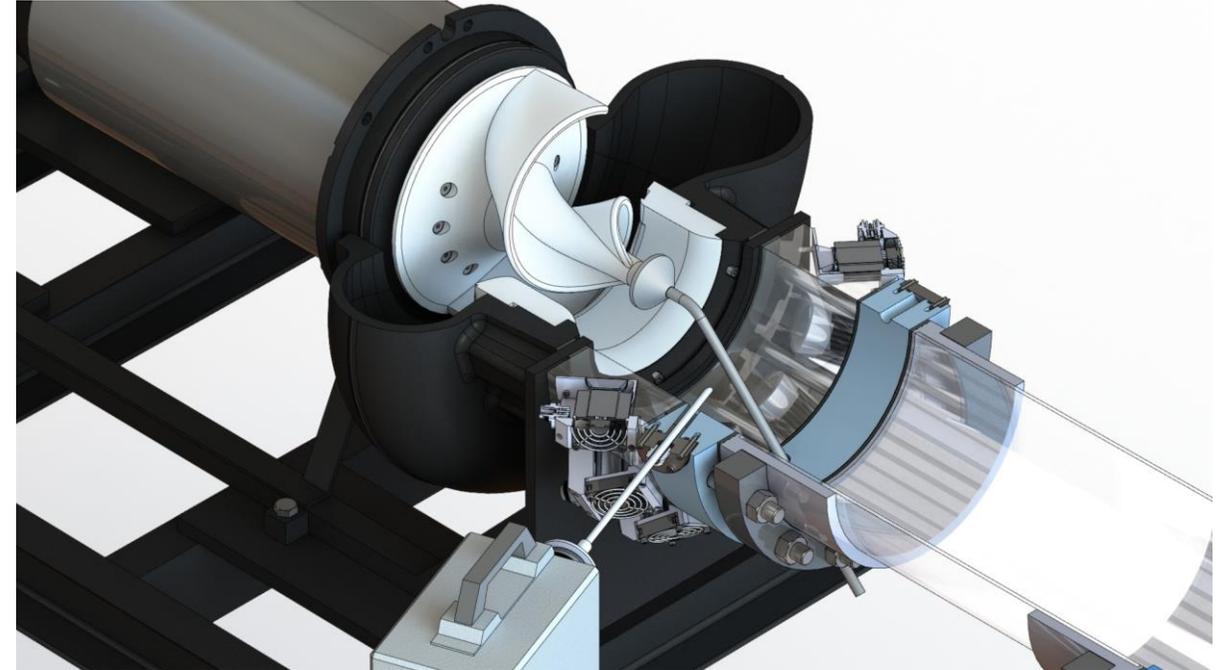
load in textiles/m ³	operation points			
	$Q/Q_{BEP} = 0.6$	$Q/Q_{BEP} = 0.8$	$Q/Q_{BEP} = 1.0$	$Q/Q_{BEP} = 1.2$
25	failed	failed	failed	failed
50	-	-	-	-
100	-	-	-	-



Konfiguration 2



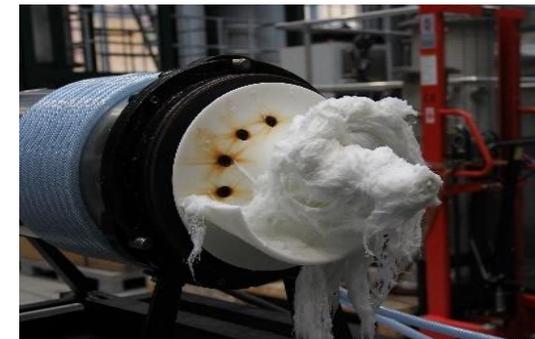
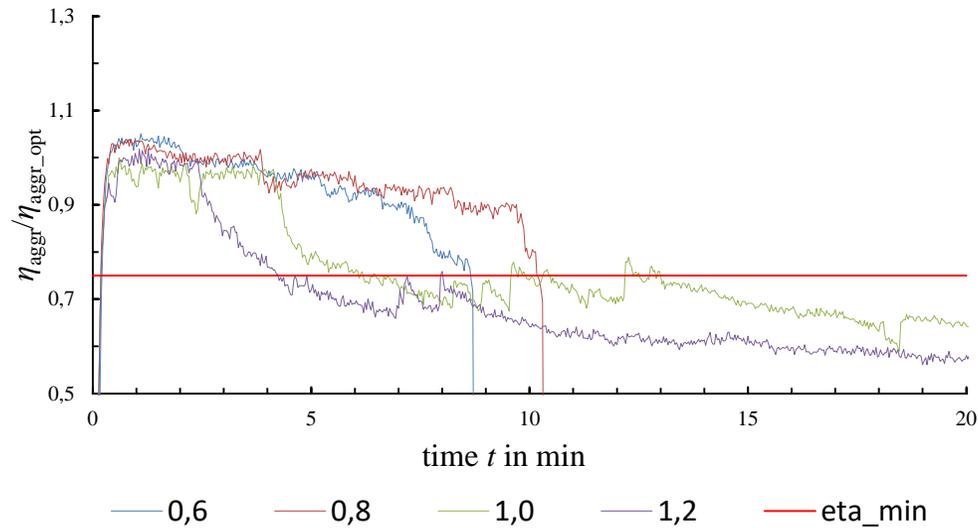
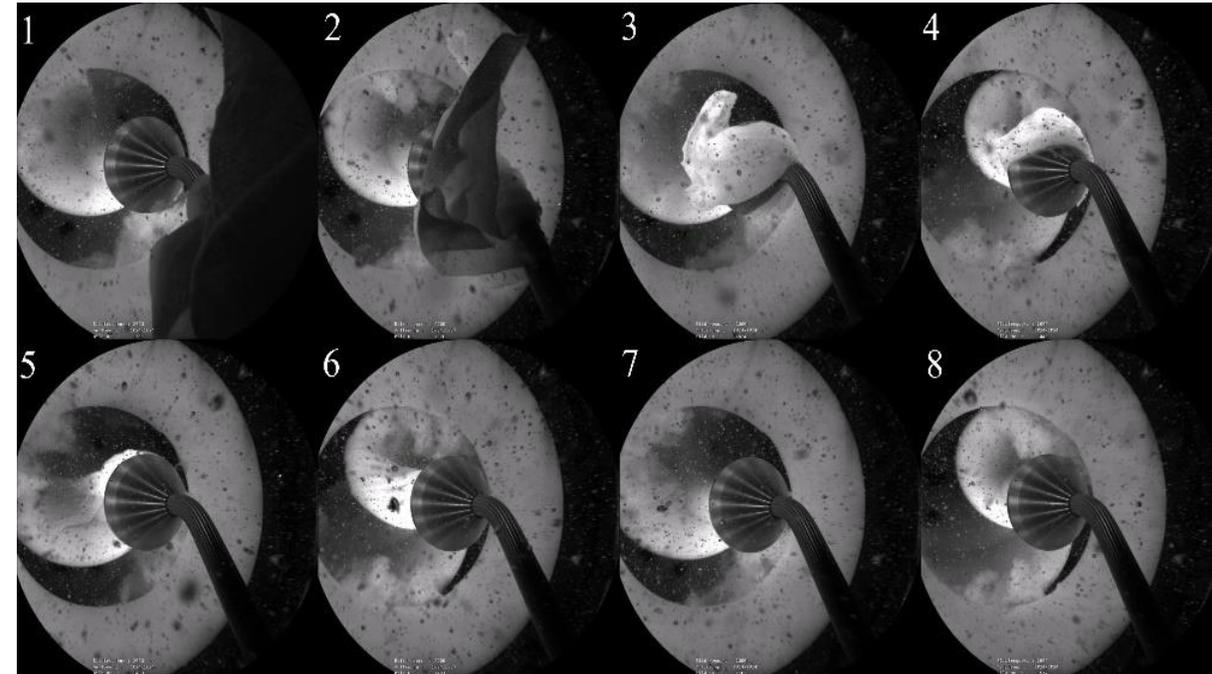
- Abdeckung der Nabenkontur über einen Konus
- Halterung im Saugrohr
- Schräge Ausführung (45°)
- Konus Durchmesser 65 mm
- Halterung Durchmesser 12 mm



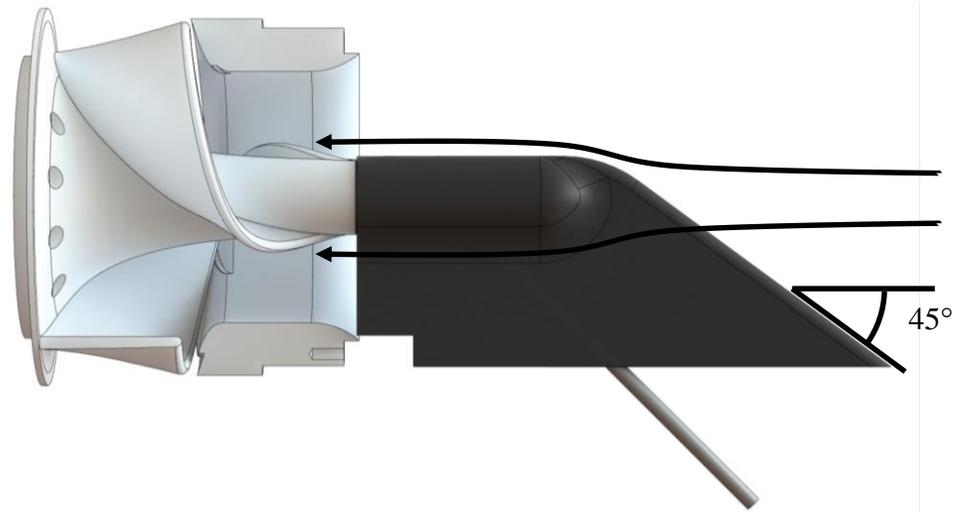
Ergebnisse Konfiguration 2

$Q/Q_{BEP} = 0.8, 25 \text{ textiles/m}^3$

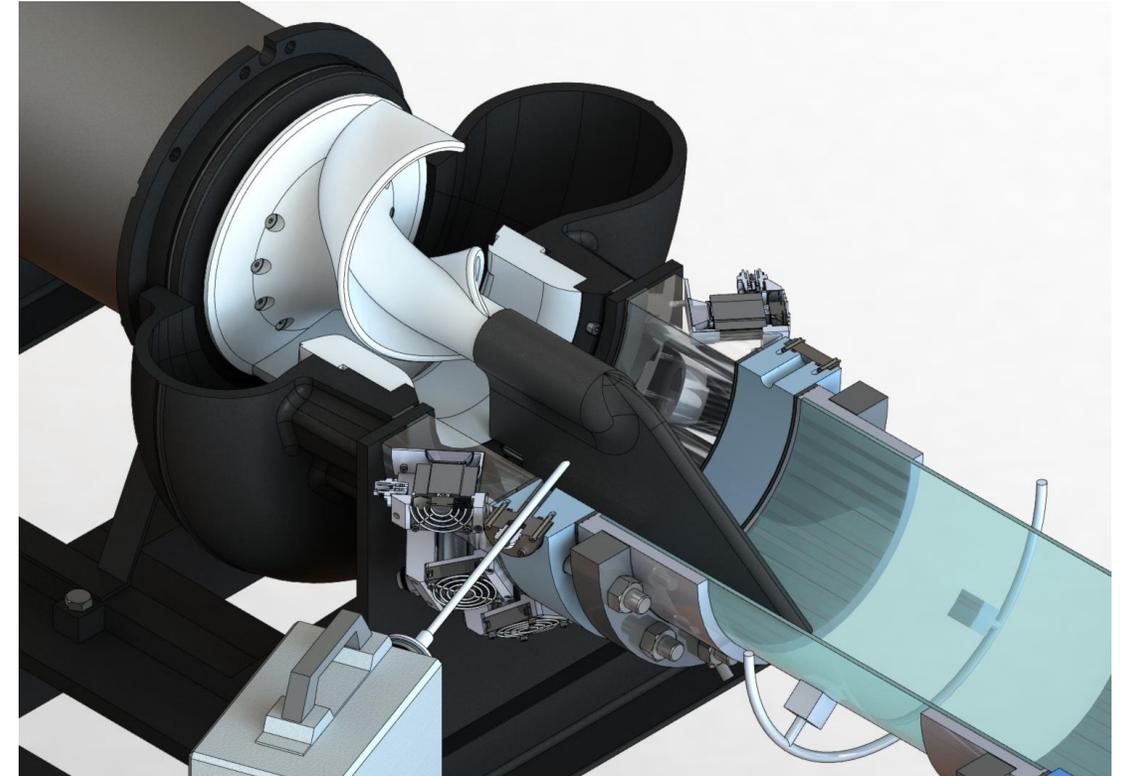
load in textiles/m ³	operation points			
	$Q/Q_{BEP} = 0.6$	$Q/Q_{BEP} = 0.8$	$Q/Q_{BEP} = 1.0$	$Q/Q_{BEP} = 1.2$
25	passed	failed	passed	passed
50	failed	failed	passed	passed
100	-	-	failed	failes



Konfiguration 3



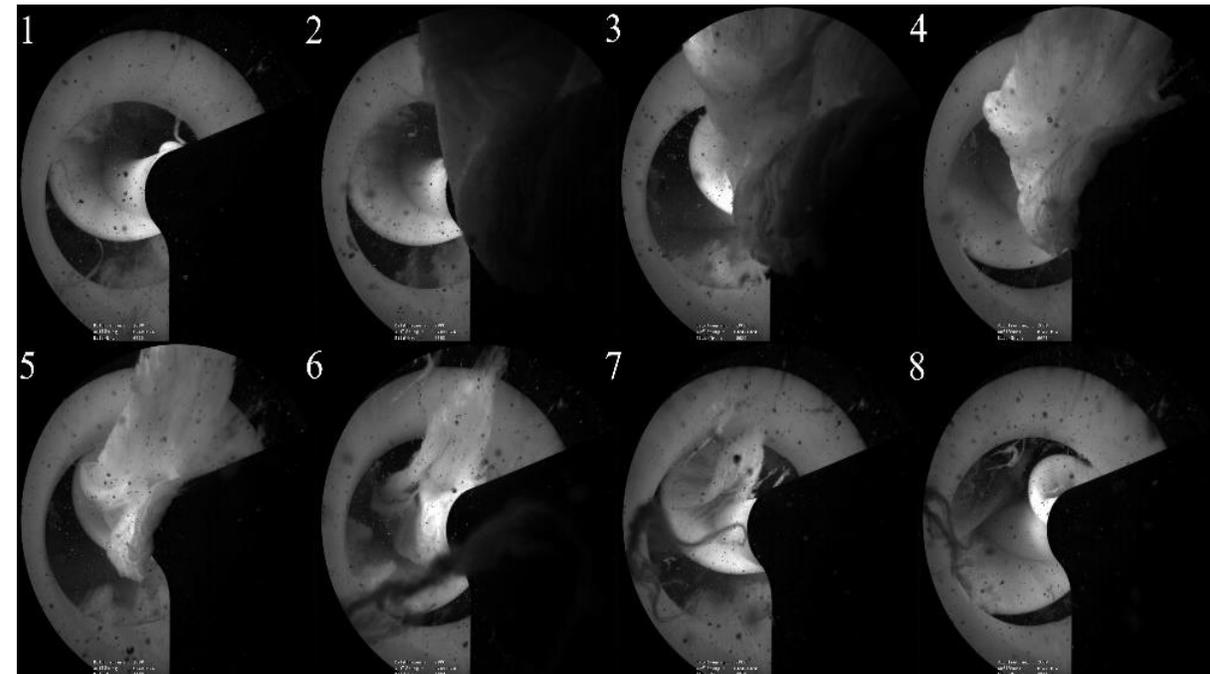
- Halterung als Finne
- Abdeckung Durchmesser 60 mm
- Angepasst an Nabenkontur



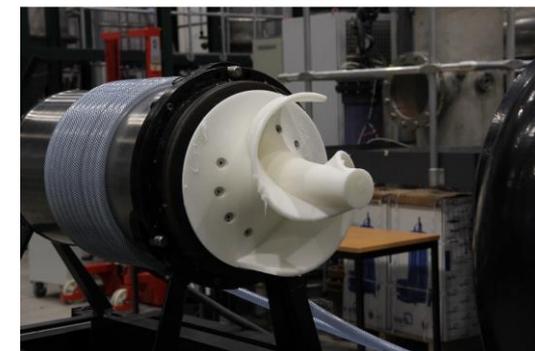
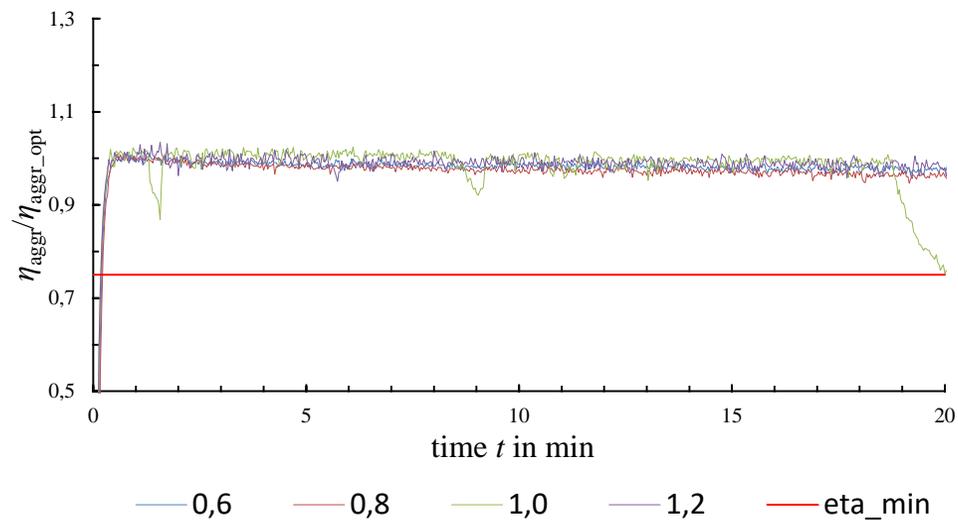
Ergebnisse Konfiguration 3

$Q/Q_{BEP} = 0.8, 100 \text{ textiles/m}^3$

load in textiles/m ³	operation points			
	$Q/Q_{BEP} = 0.6$	$Q/Q_{BEP} = 0.8$	$Q/Q_{BEP} = 1.0$	$Q/Q_{BEP} = 1.2$
25	passed	passed	passed	passed
50	passed	passed	passed	passed
100	failed	passed	passed	passed

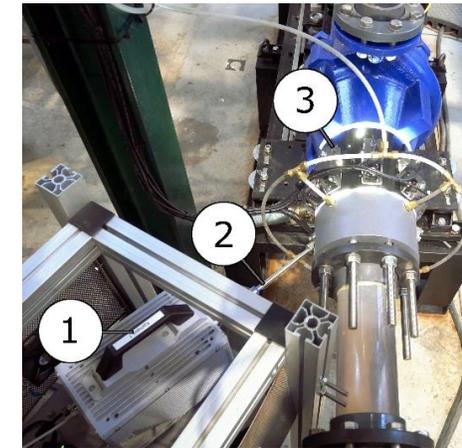


100 textiles/m³

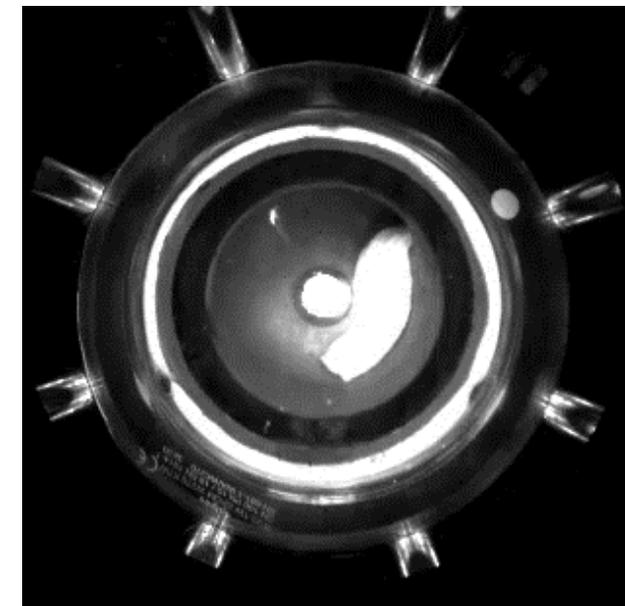


- Aktuelle LED-Lichttechnik plus High-Speed Kamera erlauben eine gezielte Beobachtung der Verstopfungsphänomene
- Damit lassen sich sowohl direkte Verbesserungen entwickeln als auch Validierungen für entsprechende Simulationen umsetzen

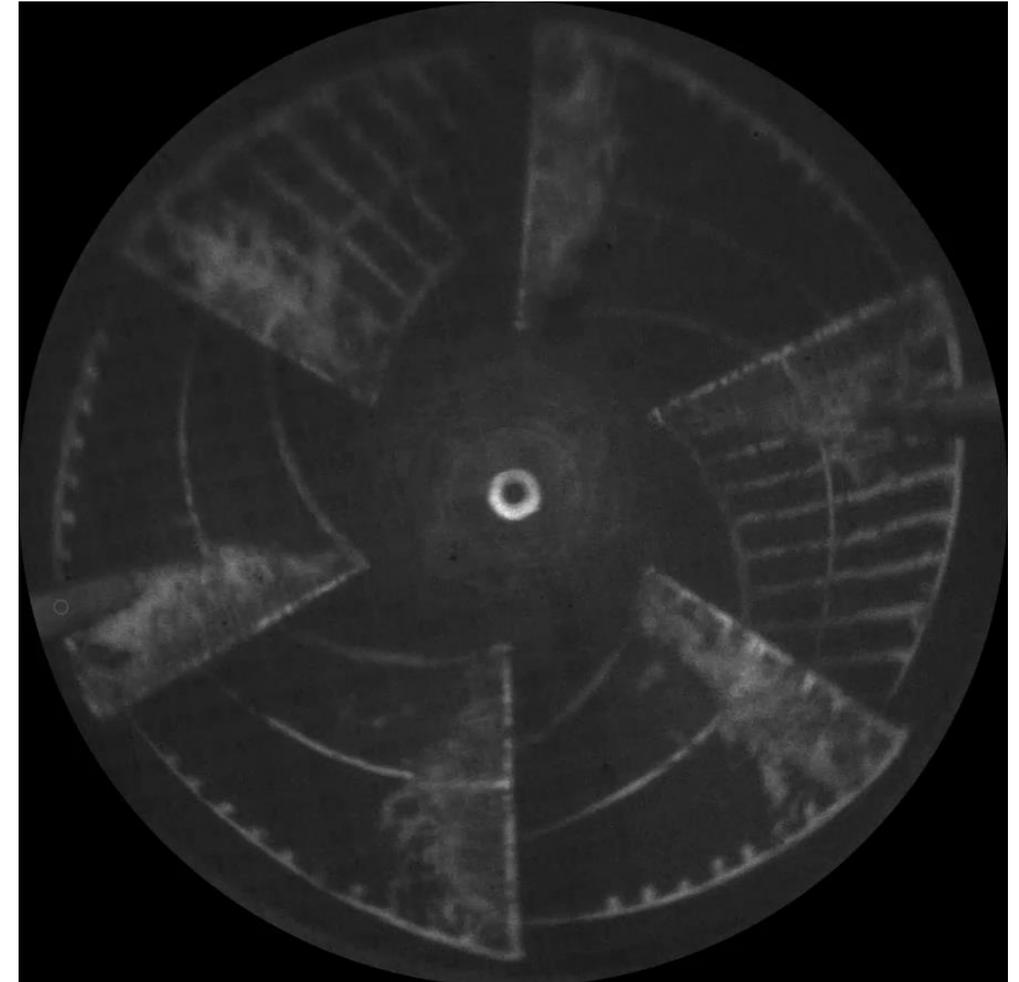
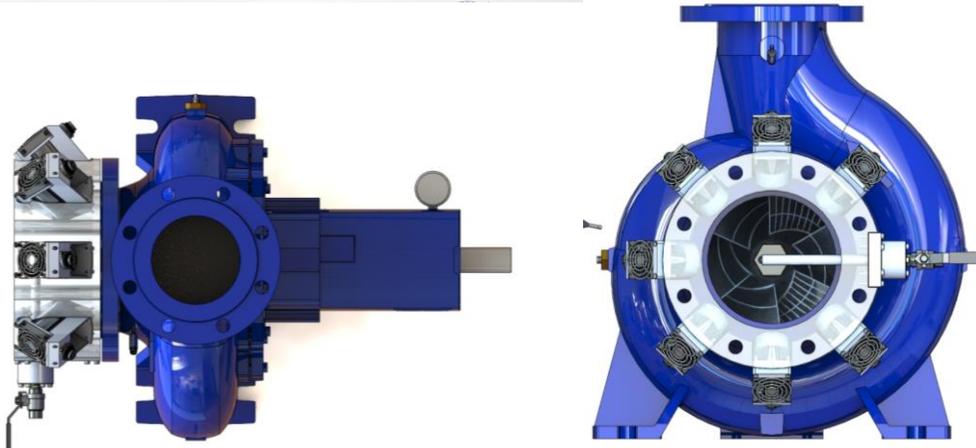
Verwendung des Optischen Zugangs bei Funktionsprüfungen



- 1) High-Speed Kamera
- 2) Lichtring
- 3) Pumpe



Verwendung des Optischen Zugangs bei Kavitationsuntersuchungen





Danke für Ihre
Aufmerksamkeit !

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