DEEPWEP

FEASIBILITY ANALYSIS OF A NON STIRRED MINIATURE BIOREACTOR

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Motivation / Introduction

The scale-up of bioprocesses is a **time-intensive** task and constitutes a major part in bioprocess development. To successfully transfer knowledge from the lab-scale to the pilot- and industrial scale, **reliable scale-up parameters** are required. The **volumetric oxygen- and energy inputs** represent such critical scale-up parameters [1-3]. In the lab-scale, high-throughput minibioreactor systems are used for bioprocess development. A high number of parallel reactors coupled with automated liquid handling and small volumes enable a **cost-efficient** generation of relevant process data.

Modern mini-bioreactor systems rely on impellers, magnetic stirrers or agitation to supply oxygen to the culture medium. Disadvantages of these systems include **temperature shifts** caused by changes of stirrer speed, **shear force gradients** and **high energy inputs** [4]. To overcome these drawbacks, the aim of this work was to assess the miniaturization capabilities of a **non-stirred 3D-printed bioreactor system** and its use in 12 mL scale.

Concept and Results

3D-printed non-stirred VS **conventional stirred**

COMPARABLE K_LA-VALUES

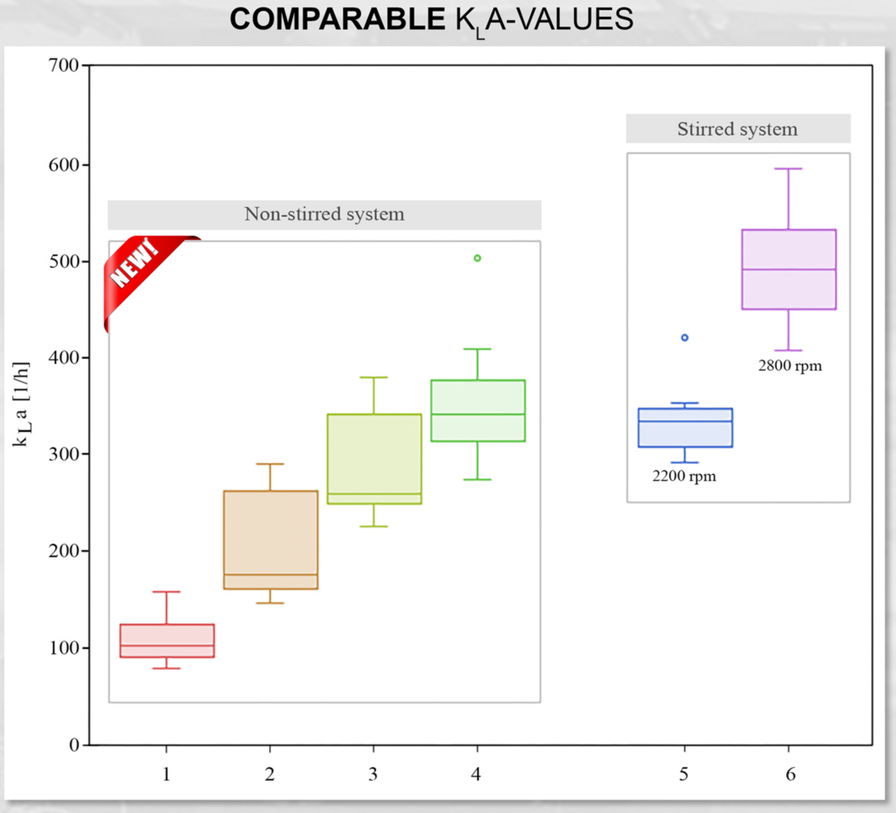

Figure 1. Comparative presentation of k_La-values for non-stirred and stirred systems with aeration of ambient air in a 12 mL minibioreactor. Each boxplot represents a total of nine measurements. The results are grouped in experiments from 1 - 6.
Non-stirred System: **(1)** Mean k_La of 109±22 h^{-1}; **(2)** Mean k_La of 203±53 h^{-1}; **(3)** Mean k_La of 287±53 h^{-1}; **(4)** Mean k_La of 352±56 h^{-1}; Stirred system: **(5)** 2200 rpm with a mean k_La of 333±29 h^{-1}; **(6)** 2800 rpm with a mean k_La of 443±38 h^{-1}.

LOWER ENERGY INPUT

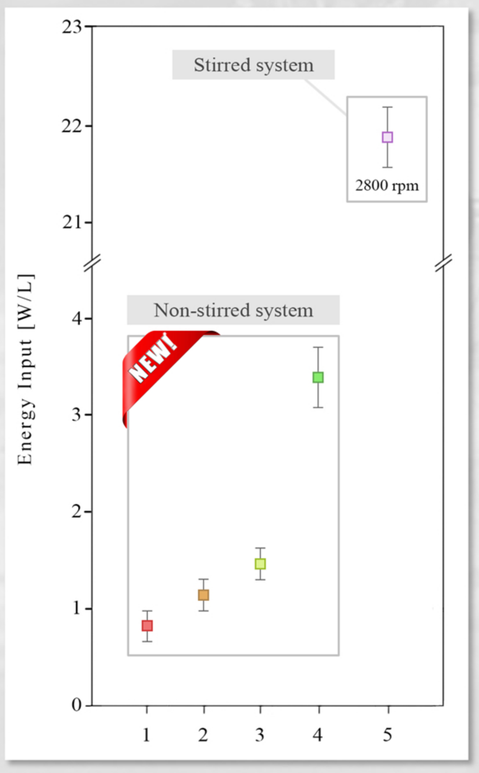

Figure 2. Comparative presentation of volumetric energy input for non-stirred and stirred systems in a 12 mL minibioreactor. Each data point represents a total of three measurements. The results are grouped in experiments from 1 - 5.
Non-stirred System: **(1)** Mean energy input of 0.81±0.15 W L^{-1}; **(2)** Mean energy input of 1.13±0.16 W L^{-1}; **(3)** Mean energy input of 1.45±0.17 W L^{-1}; **(4)** Mean energy input of 3.37±0.31 W L^{-1}; Stirred system: **(5)** 2800 rpm with a mean energy input of 22.00±1.68 W L^{-1}.

LOWER TEMPERATURE FLUCTUATIONS

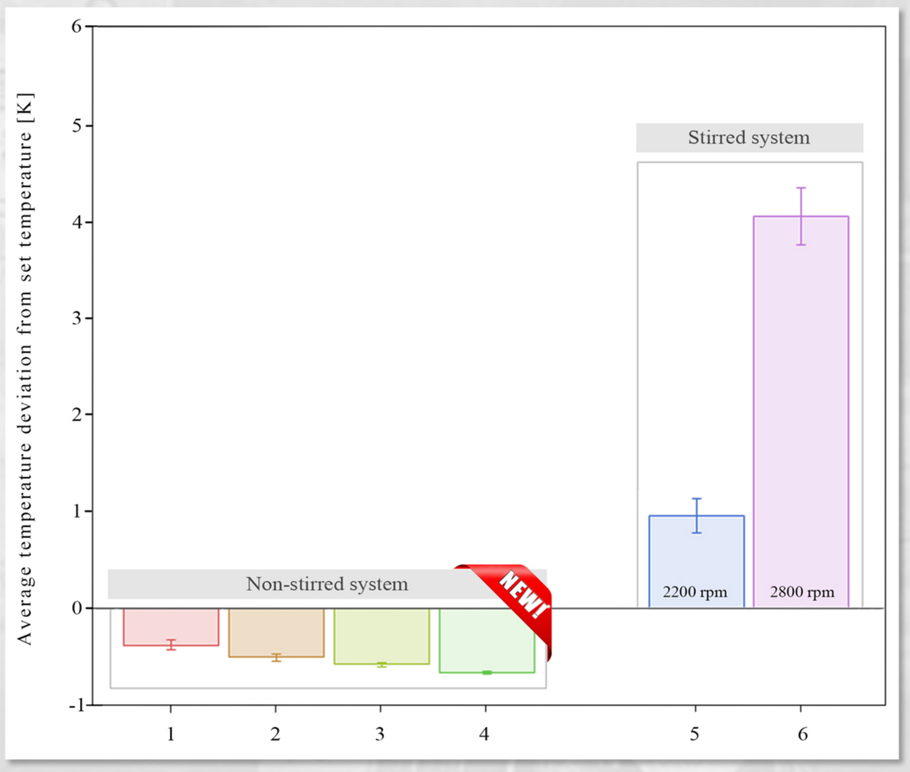

Figure 3. Average temperature deviation from set-temperature of a non-stirred system and a stirred system during k_La-experiments in a 12 mL minibioreactor. The results are grouped in experiments from 1 - 6.
Each group represents a total of nine measurements. Non-stirred System: **(1)** Temperature deviation of -0.38±0.05 K; **(2)** Temperature deviation of -0.51±0.03 K; **(3)** Temperature deviation of -0.58±0.02 K; **(4)** Temperature deviation of -0.66±0.01 K; Stirred system: **(5)** Temperature deviation of 0.96±0.17 K; **(6)** Temperature deviation of 4.04±0.29 K.

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Let's bring this system to market.

Conclusion and Outlook

In this study, the feasibility of a non-stirred minibioreactor could be demonstrated. Temperature profiles and volumetric energy inputs of the non-stirred system indicate its beneficial use in high-throughput systems compared to stirred systems. To validate these results, a cultivation in the developed system is proposed for future research. This work contributes to the development of **novel minibioreactor systems** and increases the variety of reactor types which can be used in high-throughput systems.

Quickie? Advance minibioreactors in 8 min!

https://sprw.io/stt-a2ef30

Acknowledgments / References

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[3] Lübbert, A.; Jørgensen, S.B. Bioreactor performance: a more scientific approach for practice. Journal of Biotechnology 2001, 85, 187 – 212.
[4] Bareither, R.; Pollard, D. A review of advanced small-scale parallel bioreactor technology for accelerated process development: Current state and future need. Biotechnology Progress 2011, 27, 2–14.

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