CHALLENGES OF MASS TRANSFER FOR PERFUSION CULTURES IN SINGLE USE BIOREACTORS PART I: OXYGEN

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Two important trends in the biopharmaceutical industry over the last 10 years are combining to provide challenges for bioprocess engineers. Firstly, the trend towards high viable cell concentration (VCC) perfusion cultures (>1 x 10^8 mL^{-1}) has increased the mass transfer requirements. Secondly, the trend towards single use bioreactors (SUBs) means weaker materials are used for the construction of bioreactors limiting the range of conditions that can be employed to meet the mass transfer requirements.

High VCC cultures have two distinct mass transfer requirements. Firstly, transferring in enough oxygen to meet the culture's oxygen demand. Secondly, removing enough carbon dioxide to prevent the partial pressure of carbon dioxide from accumulating to inhibitory levels. This poster focuses on oxygen mass transfer, our second poster focuses on carbon dioxide mass transfer.

Lonza have characterised the oxygen mass transfer in a number of SUB systems with respect to vessel design, oxygen enrichment, power dissipation and gas flow rate. In this poster we will present oxygen mass transfer results as a function of these factors. For each SUB design, the resulting capability space has been analysed. The window of operation capable of delivering sufficient oxygen to support GS® CHO cell lines at VCCs of $1x10^8$ mL^{-1} has been identified. The impact of vessel design on oxygen transfer and the viable window of operation is discussed.

The data show:

- Impeller design has an important impact on oxygen mass transfer but scale-up of impeller design is non-trivial.
- The design of currently available SUBs gives diminishing returns on increased gas-flow rate within the expected range of operation for high VCC cultures.
- Micro spargers are required to meet the oxygen transfer demands of high VCC cultures in current SUB designs.