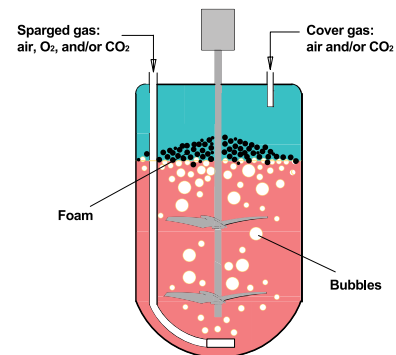


Cell Culture by Design

Dynamic Gas Control (DGC) Technology

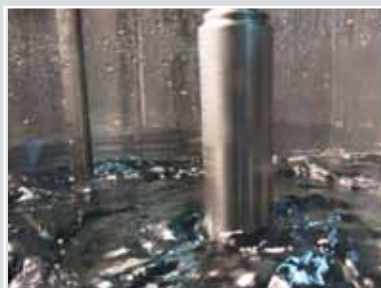
Cell Culture Today

- Small liquid surface-to-volume ratio limits gas exchange
- Hydrostatic pressure favors gas dissolution, not removal
- Vigorous mixing increases shear and foaming
- Sparged gas can cause cell damage and foaming
- Antifoaming additives foul downstream processing



Key Cell Culture Parameter	Current Control Strategy
Dissolved Carbon Dioxide (dCO ₂)	Removal of dCO ₂ by gas purging restricted by need to limit cell damage and foaming <i>High dCO₂ slows growth & reduces yield</i>
pH	Base addition controls pH at optimum value but increases osmolality
Osmolality	Uncontrolled – Osmolality trends upwards throughout process <i>High osmolality slows growth & reduces yield</i>

Praxair's DGC Technology



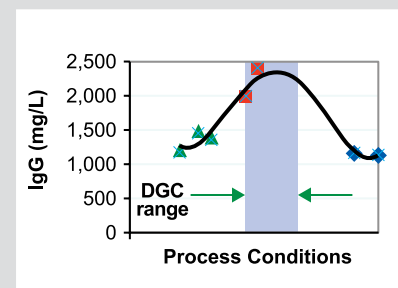
Bubble-free gas exchange equipment for bioreactor

+



Computer hardware and software for dynamic gas control (DGC)

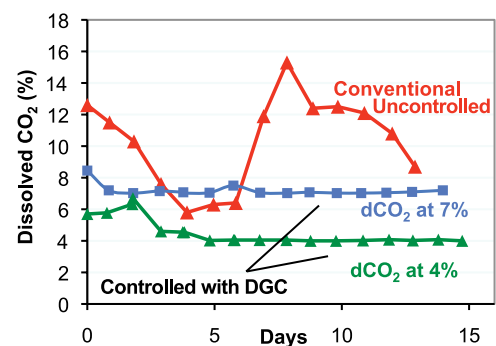
+



Process optimization and technical support

DGC technology independently manages dissolved CO₂, pH, and osmolality in mammalian cell culture.

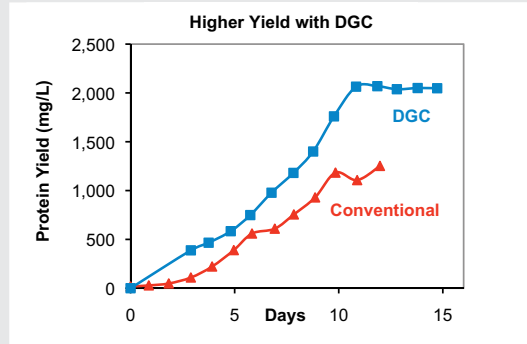
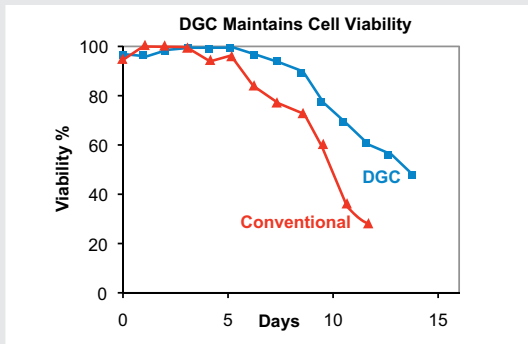
- Innovative tool to optimize yield and product quality
- Improves mass transfer to enable precise dCO₂ control
- Avoids base addition for regulating dCO₂ effect on pH
- Prevents osmolality reaching deleterious levels
- Compatible with existing processes and equipment
- Simple to install and remove



DGC technology (continued)

Potential Benefits	By alleviating physiochemical and bubble shear stresses, Dynamic Gas Control technology can improve cell viability and protein yield without nutrient modifications
Advantages	Increase yield – 50-100% more product without additional media
	Simplify scale-up from product development to commercial production
	Reduce or eliminate foaming
	Reduce impurities and improve downstream purification
	Impact increases with cell culture scale
	Requires no new materials or consumables

Improve Cell Viability and Protein Yield



Reduce Foaming

Praxair's DGC technology can dramatically reduce foam during processing. Foam adversely impacts cell culture performance by reducing the bioreactor working volume and damaging cells. Foaming is currently controlled with antifoam which negatively impacts oxygen transfer and downstream processing.



Foaming at high sparge rate in conventional bioreactor



Reduced foaming with DGC technology

To learn more about Praxair's Dynamic Gas Control technology, contact Nigel Grinter, Ph.D., at 630-320-4232, nigel_grinter@praxair.com or Alan Cheng, Ph.D., 630-320-4237, alan_cheng@praxair.com.



© Copyright 2011 Praxair Technology, Inc. All rights reserved

Praxair, the *Flowing Airstream* design and *Making our planet more productive* are trademarks or registered trademarks of Praxair Technology, Inc. in the United States and/or other countries. Other trademarks used herein are the registered trademarks of their respective owners.

The information contained herein is offered for use by technically qualified personnel at their discretion and risk without warranty of any kind.

P-10390 1/11

Praxair, Inc.
39 Old Ridgebury Road
Danbury, CT 06810-5113
USA

www.praxair.com
info@praxair.com

Telephone:
1-800-PRAXAIR (1-800-772-9247)
(716) 879-4077

Fax:
1-800-772-9985
(716) 879-2040