Liquid Injection System (LIS)

Automated Feeding of Liquids in Shake Flasks

aquilabiolabs

LIS is the first easy-to-use technology allowing for automated feeding of liquids in shake flask cultures.

LIS Technology

LIS consists of three components that can be easily set up: the LIS Drive, the LIS cartridge and optionally the LIS software.

LIS – Components and Set-Up

1 Fill the LIS Cartridge

The LIS cartridge is a sterile single use container that has the shape of a shake flask lid.

Under a sterile hood, fill the LIS cartridge with up to 25ml of the liquid that you want to feed to your culture.

2 Program the LIS Drive

The LIS Drive is a miniature pump that controls the feeding of the liquid from the LIS cartridge into the flask.

Define your feeding profile and program the LIS drive accordingly. You can either program the Drive directly or use the LIS software to control LIS wirelessly.

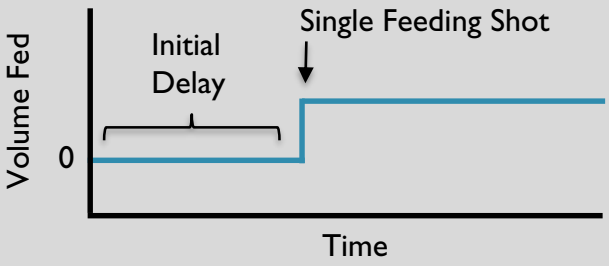
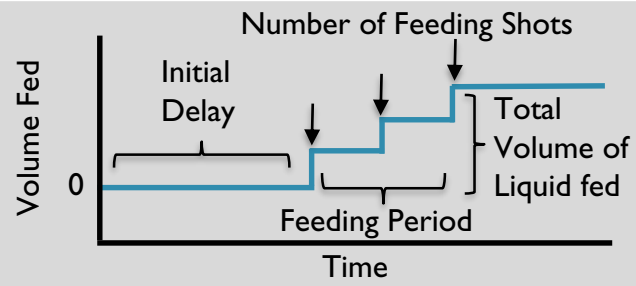
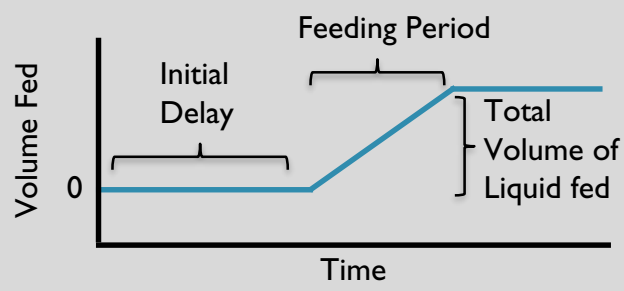
3 Install LIS on Your Flask

LIS is the first technology for the automated feeding of liquids into shake flasks.

Mount the LIS drive onto the LIS cartridge and install it on the shake flask. LIS will now automatically run your feeding profile.

Various predefined feeding profiles allow users to quickly create individual feeding strategies for their shake flask cultures.

LIS Feeding Profiles

	Feeding Profile	Feeding Parameters	Description
Single Shot		– Initial Delay [min] – Volume of Feeding Shot [µl]	Allows you to feed a certain volume to your culture after a defined initial delay. This profile could be used for e.g. an induction with IPTG.
Multi Shot		– Initial Delay [min] – Feeding Period [min] – Total Volume that should be fed [µl] – Number of Feeding Shots during Feeding Period	Allows you to feed a certain volume in a defined time period. The liquid will be distributed evenly among a defined number of shots. This profile could be used for e.g. a fed batch experiment.
Constant		– Initial Delay [min] – Feeding Period [min] – Total Volume that should be fed [µl]	Allows you to feed a certain volume in a defined time period. The liquid will be distributed linearly over time. This profile could be used for e.g. a fed batch experiment.

Additional feeding profiles are available in the LIS Software.

LIS is compatible with various substances such as sugars, alcohols as well as acids or bases.

LIS – Compatible Substances

Substance	Compatibility of substance with LIS			
	Unlimited	Under most circumstances	Can not be used	Not tested
Sugar Solutions (e.g. up to 50% Glc)	×			
Viscous Solutions (e.g. up to 75% Glycerol)	×			
Aqueos Solutions (e.g. IPTG, Media, Acids, Bases, Buffer)	×			
Alcohols (e.g. 50% Ethanol, 75% Methanol)		×*		
Antifoam		×**		
Organic Solvents				×
Phages				×
Suspensions				×
Solid Materials			×	

* Based on the alcohol, concentration and temperature, evaporation may influence the accuracy

** Accuracy can vary for different types of antifoams

LIS is compatible with all common laboratory shakers and shaking conditions.

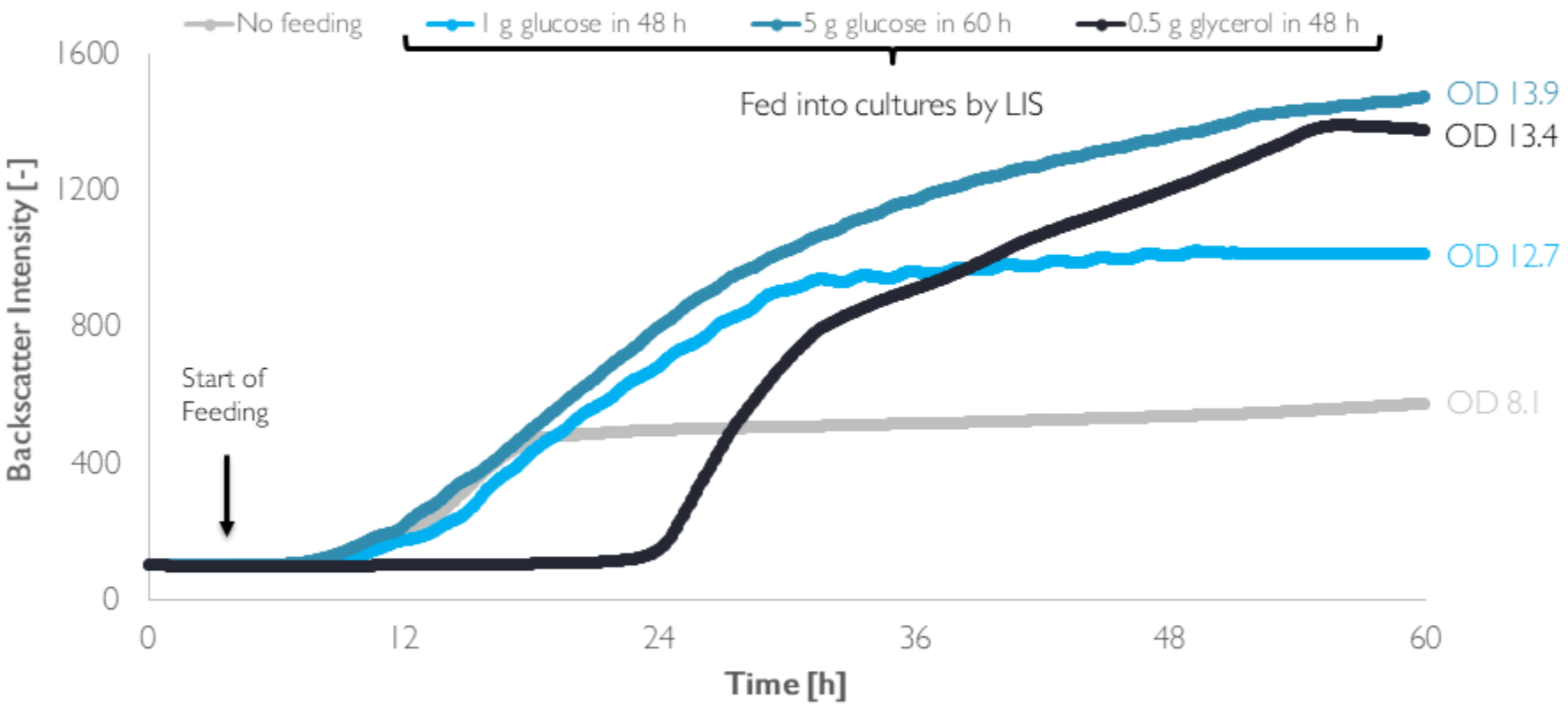
LIS – Compatible Maximal Shaking Conditions

Shaking diameter	Flasks fixed on tray with	Set-Up	Shake Flask Size (Total Volume)				
			100ml	250ml	500ml	1000ml	2000ml
25mm	Clamps	Shake Flask only	250	300	250	250	250
		Shake Flask + "New" CGQ Sensor	250	300	300	300	250
		Shake Flask + "Old" CGQ Sensor		300	300	300	250
	Sticky Stuff	Without CGQ Sensor	200	200	200	250	250
50mm	Clamps	Shake Flask only	250	250	225	225	200
		Shake Flask + "New" CGQ Sensor	200	250	250	225	200
		Shake Flask + "Old" CGQ Sensor		250	225	225	200
	Sticky Stuff	Without CGQ Sensor	200	200	200	250	250

Tests were performed with a flask filling volume of 10 % and 20 ml filling volume of the LIS cartridge.
All data is shown in rounds per minute (rpm).

LIS is the first easy-to-use technology allowing for fed-batch experiments in shake flask cultures.

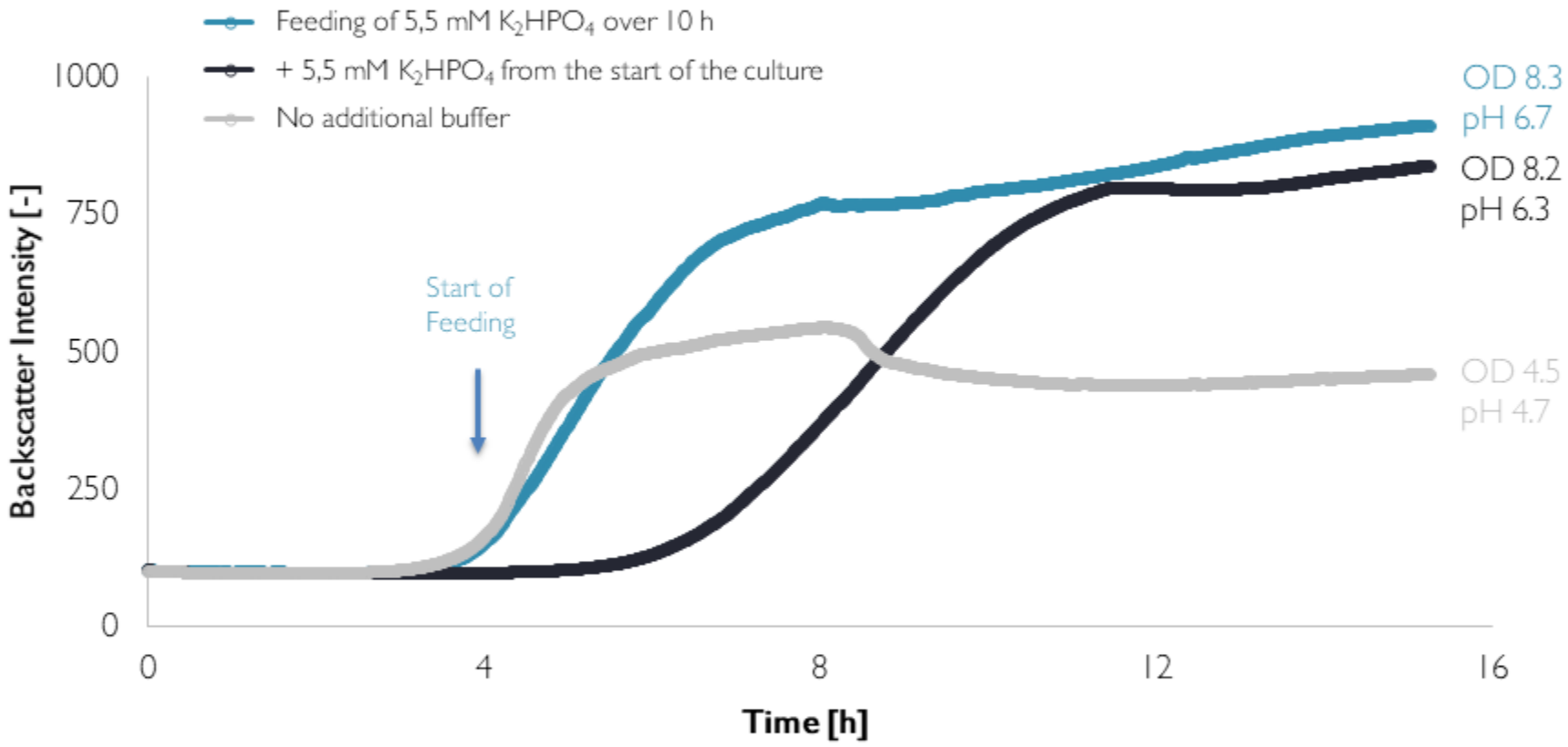
Exemplary Use Case LIS (1/2) – Fed-Batch



S. cerevisiae cultures were grown on YPD media. Cultures were perfomed in 250 ml shake flasks with a filling volume of 10 % at 30 °C and shaken at 250 rpm. Additional carbon source was fed to three cultures using the LIS technology. Either glucose or glycerol was fed to the cultures over a time period of 48 or 60 h by using a constant feeding profile. Biomass of the cultures was monitored online by the CGQ technology (aquila biolabs). Optical Density (OD) was measured offline at the end of the cultures.

LIS can be used to control pH drifts to *E. coli* shake flask cultures by automatically feeding buffer to the culture

Exemplary Use Case LIS (2/2) – pH Regulation



E. coli cultures were grown on LB media + 2 % glucose. Cultures were performed in 250 ml shake flasks with a filling volume of 10 % at 37 °C and shaken at 250 rpm. Additional buffer was fed to one culture using the LIS technology. 2 ml of K_2HPO_4 were fed to the culture over a time period of 10 h by using a constant feeding profile. Biomass of the cultures was monitored online by the CGQ technology (aquila biolabs). Opitcal Density (OD) was measured offline at the end of the cultures.