Technical Note:

Guide to Selecting the Correct Spinner Flask

Introduction

Selecting the appropriate spinner flask configuration (volume, number and location of side arms, type of impeller, jacketed etc) is crucial for successful cell culture experiments whether for suspension cell culture or microcarrier based cultures. This becomes more critical when the spinner flask selection is a precursor to scaling up the process into larger spinner flasks, or when using spinner flasks to identify the correct operational parameters for transfer of a process to a stirred tank bioreactor.

Flask Material

Glass spinner flasks come in a wide variety of sizes (Bellco supplies glass spinner flasks from 25mL to 150L volume) and with a wide range of flask designs and number of side arms. Glass is durable, reusable, and ideal for long term use. It requires cleaning and sterilizing by autoclave. Glass is breakable but this can be mitigated by using safety coated spinner flasks that are more resistant to breakage. Impellers are typically made from either stainless steel, PTFE or glass to ensure long life and ultra-low levels of extractables during use. Glass spinner flasks should always be autoclaved assembled, and positioned vertically in the autoclave, not lying on their side.

Disposable spinner flasks are typically made of polystyrene or other plastics and are typically supplied assembles and presterilized by gamma irradiation, with a certificate of sterility or irradiation from the supplier. Typically, disposable spinner flasks are available in a limited number of volumes and formats (number, size and position of side arms, and types of impellers). Prior to use it is always a good idea to evaluate the level of extractables that may leach out of the plastic components and into the cell culture media to ensure there are no deleterious effects on cell growth.

Volume and Scale

Select a spinner flask that meets the needs of the experimental design. Please note that if this includes scaling up the experiment to larger volumes, the largest disposable plastic spinner flask available is 3L (with a maximum working volume of 1.5L.) Glass spinner flasks are available up to 150L in size and custom sizes can be produced.

Temperature Control.

Smaller spinner flasks are typically used with a magnetic stirrer (single or multi-place) and the assembly is placed in an incubator. It is critical to ensure that there is enough headspace in the incubator to accommodate the spinner flask and magnetic stirrer, and that the incubator has internal electrical outlets to plug in the stirrer. A temperature blanket can also be provided to maintain temperature if the spinner flask is used on the bench or inside of a laminar flow hood (LAH). Glass spinner flasks can be manufactured with an integrated water jacket through which water can be circulated to maintain the optimal temperature for cell growth. Note that water jacket options are not available on disposable spinner flasks. Also if using a CO_2 incubator, please make sure that the magnetic stirrer is compatible.

Mixing Mechanism.

Spinner flasks can be used either on a magnetic mixer, or for larger systems where a magnetic mixer is not appropriate, an overhead drive unit can be used.

- **Magnetic** stirring is common in smaller volume spinner flasks (>8L) and provides gentle, uniform, smooth mixing that does not damage cells. Disposable spinner flasks can only be used with bottom mounted magnetic mixers.
- **Overhead** mixing is typically used on larger volume spinner flasks (5L and above), or on smaller systems where the viscosity of the culture is too high to allow efficient mixing using a magnetic mixer and a higher torque drive system is required. If using an overhead drive-unit it is critical to select the correct impeller design to ensure efficient mixing and low cell mortality.

Flask Bottom Design

Flasks are available with either flat or dimpled bottoms.

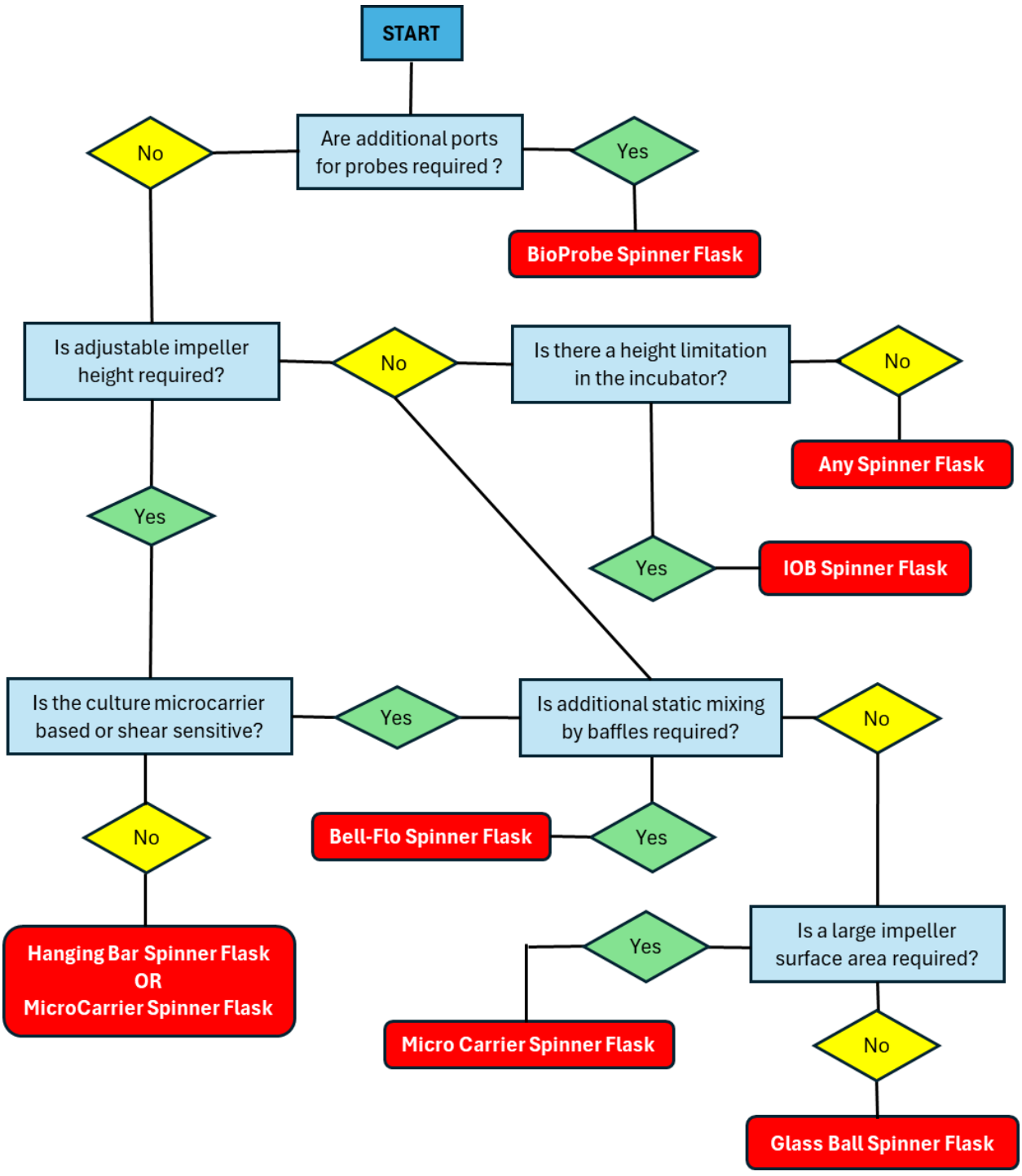
- **Dimpled bottom flasks** are recommended when using microcarrier based cell cultures. The dimple prevents microcarrier accumulation directly below the impeller, helps maintain even microcarrier dispersion throughout the culture ensuring uniform nutrient and oxygen supply and allows for easier sampling and media exchanges.
- **Flat bottomed flasks** promote optimal growth in suspension cultures by providing continuous agitation together with uniform oxygen and nutrient distribution in the media. The flat bottom allows for easy handling and is very versatile, being able to be used with a wide variety of cell types and for a wide range of applications.

Impeller Design Selection for Magnetic Mixer Driven Systems

The impeller performs multiple functions in the spinner flask

- **Agitation**. This ensures that the cells, nutrients, oxygen and microcarriers is used are uniformly dispersed throughout the culture media.
- **Settlement prevention**. Ensures that the cells or microcarriers do not settle or gravitate to the bottom of the spinner flask during the culture process.
- **Aeration**. By providing continual exposure of fresh media to the gas/liquid interface the impeller maintains the correct amount of oxygen in the culture for optimal cell growth.
- **Adjustable height**. Some impeller designs can be adjusted to operate at different heights above the flask bottom, this allows the mixing process to be optimized for each experiment.
- **Large surface area.** Large impellers can be used to provide efficient mixing at low speeds and are especially useful for shear sensitive cell lines to prevent cell loss or damage.

Selection Guide for Standard Bellco Glass Spinner Flasks



Impeller Design Selection for Overhead Drive Mixers Systems

When used with overhead drives there are a number of different impeller types that Bellco supplies that are connected to the overhead drive unit. The selection of the right impeller design is essential to obtain the best results from the system, all impellers should be 316l stainless steel with an electropolished Ra32 finish.

Rushton Impeller

- Provides radial (horizontal) flow mixing.
- Can create a surface vortex
- Excellent with organisms that can withstand high shear conditions.
- Drives high oxygen transfer rates.
- These are commonly used for microbial applications and aerobic fermentation applications.

Marine Impeller

- Provides axial (vertical) flow mixing.
- Ideal for shear sensitive and delicate organisms.
- Gentle mixing applications at low shear rates.
- Axial flow is an efficient mixing system for low impeller and therefore low tip speeds.

Paddle Impeller

- Provides a constant laminar flow of liquid in the vessel
- Minimizes vortex formation
- Provides enhanced mixing homogeneity
- Effective at slow speeds – good for shear sensitive materials
- Effective with viscous and semi solid solutions because of large surface area of paddle.

Pitch Blade Impeller

- Creates a balanced flow of both axial and radial mixing
- Provides a combination of efficient mass transfer and gentle mixing
- Can create a surface vortex at high speeds
- Not recommended for very shear sensitive applications

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