What are the cleaning guidelines for the Panlab Langendorff System?

**Cleaning**

It is essential to maintain the Langendorff system in a clean condition as the physiological perfusate solutions support bacterial and fungal growth. Daily and fortnightly cleaning protocols are described below. Adequate maintenance will prolong the life of your equipment!

**Use a germicide**

To minimize the growth of algae and microorganisms in the water bath and tubing of the heating system, always use deionized (or distilled) water. A cationic surfactant and germicide can be used to keep the water bath free of bacterial and algal growth. ‘Sigmaclean’ water bath treatment (Product Number S5525, CAS Number: 68424-85-1), from Sigma, used at a dose of 0.16 mL/L or 0.02 oz/gal., is suitable. This should keep the heating system clean between the fortnightly cleaning protocol, however, if slight turbidity in the waterbath is observed, then drain and refill the waterbath with dilute domestic bleach (sodium hypochlorite solution) — use about 25 mL of 4% bleach per litre of water. Allow to stand for about 10 minutes, then drain and rinse with deionized water, and then refill with fresh deionized water containing the germicide.

**Do not autoclave**

Note that the Langendorff glassware is mainly constructed of Perspex (or acrylic). Under no circumstances should you subject the system to autoclaving.

**Do not use boiling water**

Boiling water may soften and distort the Perspex of the Langendorff glassware. Do not use water hotter than 80 °C when cleaning the system.

**Do not use organic solvents**

Do not use alcohol, or other organic solvent based cleaning agents, as these can damage the Perspex surfaces.

**Do not use abrasives**

Avoid the use of all abrasive pastes and scourers such as steel wool. These will damage the Perspex surfaces of the water and perfusate reservoirs and make future cleaning more difficult.

**Do not use aggressive chemicals**

Aggressive chemicals, such as concentrated hydrochloric acid, sulfuric acid and sodium hydroxide can damage the system and should never be used.

**Daily cleaning protocol**

After daily use the perfusion system and heart chamber should be cleaned (the waterbath need not be emptied to do this):

1. Keep a slow gas stream passing through the bubblers to prevent solution from entering the gas lines.
2. Remove all perfusate solution from the system and flush the perfusate reservoirs and connection tubes with tap water then deionized water. If necessary, you can also flush with hot (65–80 °C) water, to dislodge any biological material. Higher temperatures may damage the surface of the Perspex reservoirs.
3. Fill the perfusion system throughout with 1 mol/L ascorbic acid solution and leave in the system overnight.
4. Next morning, remove the ascorbic acid solution and retain (it can be reused 6–8 times) then purge the system thoroughly with tap water followed by deionized (or distilled) water.
5. Refill the reservoirs with perfusate solution for the new experiment.

**Fortnightly cleaning protocol**

This protocol should be followed every two weeks, or before storage.

**Perfusate reservoirs and waterbath**

Clean as follows:

1. Before cleaning, all connection tubing should be disassembled, and the waterbath and perfusate reservoirs should be emptied. Ensure that the bubbling regulators for each perfusate reservoir have been closed.
2. Use a soft nylon brush and a detergent solution (non-foaming, if possible) to clean inside the perfusate reservoirs, water bath and heart chamber. Drain and then rinse with deionized water.
3. If there are still persistent algal stains, fill the reservoirs and water bath with diluted household bleach (sodium hypochlorite solution). Use about 25 mL of 4% bleach solution in about 1 L of water. Allow to stand for 10 minutes. Drain and flush with large quantities of tap water. Repeat step 2.
4. Check that the bubbling system still works.
5. If the system is to be stored, allow all parts to dry thoroughly.

**Heart chamber**

In cases of severe soiling, disconnect the glass heart chamber from the system and immerse it in full strength domestic bleach solution (4% available chlorine), and leave overnight. After a thorough cleaning with detergent solution, tap water and deionized water, reconnect the heart chamber to the system. Never use full strength bleach to clean tubing or Perspex surfaces.