STANDARD OPERATING PROCEDURE

Pressure Cell, French

Model: FA-078
Manufacturer: Aminco (American Instrument Company), Division of Travenol Labs
Location: Fermentation Facility Support, 1620 Food Sciences Building
Publication Date: 01/21/2015
Description and Uses

The French pressure cell or “French press”, invented by Stacy French of the Carnegie Institution of Washington, D. C., is used to disrupt cells by passing them through a narrow valve under high pressure. It can disrupt plant and microbial cell walls while leaving the nuclei intact. Other uses include disintegrating chloroplasts, animal tissue homogenates and other biological particles. A French press is commonly used to break the resilient cell walls of bacteria and other microorganisms for isolation of proteins, enzymes and other cellular components. The press uses a hydraulic pump to drive a piston within a larger cylinder that contains the liquid sample. The highly pressurized sample is then squeezed through a needle valve during which the fluid undergoes shear stress and decompression, causing cellular disruption. The major components of the press are made of stainless steel to prevent sample contamination. In the press, shear forces are carefully controlled by adjusting the piston pressure. The press provides a single-pass through the point of maximum shear force, limiting damage to delicate biological structures due to repeated shear, as can occur with other disruption methods. Before use, the pressure cell is chilled to preserve enzymatic and other biological activities of the sample. Disadvantages of the press include its inapplicability for large sample volumes, and its difficulty to move, manipulate and clean due to its heavy weight (~15 Kg). Additionally, certain types of samples may clog the valve.

Power Specifications for the Hydraulic Press

Voltage/Amperage: 115V/15A

Potential Hazards and Safety Precautions

Standard Voltage (115-V)/Possible Electric Shock

• Use of the cell requires an electrically operated hydraulic press. Make sure that the wall outlet receptacle is properly wired and grounded, and matches the instrument’s power cord and plug.

• Make sure the area around the outlet, floor and your hands are completely dry when plugging or unplugging the electrical cord to/from the outlet.

Fire Safety/Explosion Hazard

• Do not use the pressure cell with materials capable of developing flammable or explosive vapors. 

  NOTE: No flammable liquids are to be used in the pressure cell!

Mechanical Safety/Excessive Weight/Possible Injury to Hands and Extremities

• The French pressure cell is heavy and can cause serious injury to hands, legs, and/or feet if dropped. Be careful in lifting and handling the pressure cell. Be sure to wear sturdy, closed-toed shoes or preferably, safety shoes with steel-toe caps.

• When in operation, the hydraulic press generates several thousand pounds of pressure. Use extreme caution in operating the press. Be sure your hands are away from the press before it is turned on.
Biohazard/Possible Illness or Physical Damage to Tissues and Organs

- Normal operation may involve use of live pathogenic or potentially pathogenic microbial cells. Wear all required personal protective equipment listed and carefully clean up any spills with disinfectants in accordance with EHS safety guidelines. Always autoclave the cell after use.

Chemical Hazard/Possible Burns or Physical Injury

- Never use any corrosive material (such as acids and bases) in the cell. **Note: Even acetate solutions are acidic.**

- Wear all required personal protective equipment that is listed below.

Required Personal Protective Equipment

- Lab Coat Hair Net (Tie Back Long Hair)
- Safety Glasses or Goggles
- Rubber, Latex or Disposable Gloves
- No Loose Fitting Clothing
- No Open-toed or Open-heeled Shoes

**Note:** Safety Shoes with Steel-toed Caps are highly recommended.

Required Training

*Denotes courses offered online

- Machine & Site-Specific Training
- Fire Safety & Extinguisher Training*  
- Laboratory Safety: Core Concepts*  
- Laboratory Safety: Spill Procedures

Operation

1. Be sure to acquire all required training, including site-specific training before operating the French Pressure Cell.

2. The “French Pressure Cell” document located in the Fermentation Facility, 1620 Food Sciences Building can help in providing a more complete description of the Pressure Cell and its uses. Be sure to read the attachment before using the Pressure Cell to become familiar with its correct operation and individual component parts. Refer to this attachment during operation.

3. Be sure to wear all required personal protective equipment previously listed.
4. Prior to operation, chill the French Pressure Cell assembly in the cold room overnight.

5. Apply a small amount of silicone grease to the O-ring located on the piston (see Figure 1).

6. Push/rotate the cylinder into the opening located at the top of the cell body and position it for the desired amount of sample to be processed.

7. Rotate the cell upside down and place it on the 3-legged filling stand.

8. Apply a small amount of silicone grease to the O-ring located on the closure-plug assembly.

9. If necessary, replace the nylon ball on the flow-valve assembly. This controls the outflow of the sample during operation.

10. Press the T-shaped valve stem into the press to seat the new ball (see Figure 1). Then, tighten the valve “finger tight” to maintain pressure. **Note: If the cell won’t maintain pressure, replace the ball. Rotating the ball 180 degrees may also correct the problem.**

11. Connect the flow valve to the cell and keep it open.

12. Fill the cell with sample fluid slightly above the outflow port to avoid air bubbles.

13. Close the cell by attaching the bottom piece with the valve open to displace any excess air.

14. Position the outlet tube so that it is pointing down in a collecting vessel. Any sample forced out by closing the cell will then go into the vessel, rather than on you or onto the machine, etc.

15. Close the valve before setting the cell upright. Also, point the outlet towards the bottom of the cell. Make sure that the bottom closure is pressed fully into the cell.

16. As you mount the cell in the hydraulic press (see Figure 2), keep your hand over the bottom of the cell to keep the bottom piece from slipping out. The other hand will hold the cell itself. **Note: If the bottom piece slips out and is not completely seated in the cell when you start to apply pressure, you may bend it and possibly, if the cell surfaces are not 100% horizontal, shoot the cell out of the press.**

17. Close the flow valve until it is “finger tight.”

18. Invert the cell and center it on the press platen using the aligning pins. Then, orient the cell so that the flow valve is accessible at the front of the press.
19. Secure the cell clamp until it is “finger tight” to lock the top of the cell in position during pressurization.

20. Connect the sample-outlet tube.

21. Position the press between the “jaws” (platens) of the hydraulic press.

22. Check that the control knob of the hydraulic press is fully counterclockwise (zero pressure) before turning it on.

23. Turn the “Ratio Selector” valve to the DOWN position.

24. Determine the pressure-gauge setting using the desired cell pressure and the table located to the right of the pressure gauge (e.g. a desired cell pressure of 14,000 psi = 886 psi gauge setting). Then, turn the pressure-control knob clockwise until the desired gauge setting is reached. **Note:** It is best to set the pressure at 900 psi (DO NOT exceed the maximum gauge reading “high” range of 1,260 psi for a 20K cell).

25. Turn the “Ratio Selector” valve to HIGH.

26. Position a collecting vessel below the outlet tube to collect the sample as it exits the cell. An option is to fasten one end of a piece of Tygon or Teflon tubing to the outlet, then insert the other end of the tubing into a collection vessel (e.g., Erlenmeyer flask, 50-mL disposable tube, etc.). **Note:** The tube should be securely fastened inside the opening of the collection vessel so that it cannot come loose. The vessel is then attached to a ring stand via a clamp. This frees the operator’s hands for easier operation of the hydraulic press and flow valve.

27. Once pressure is achieved, **very slowly and carefully** open the flow valve on the cell by turning the T-shaped valve stem to begin a slow drip from the sample outlet into the collection vessel. Gently finger-tap the valve to adjust the flow rate. When you are done and your sample has stopped flowing out, open the valve completely to make sure there is no pressurized gas within the cell before stopping the press (see Figure 3).

28. After the sample has been successfully processed, turn the “Ratio Selector” valve back to the DOWN position to lower the platen.

29. Turn the pressure knob fully counterclockwise (zero pressure) before turning the pump off. Flip the pump switch to OFF when the platen reaches its lowest position.

30. Remove the pressure cell from the hydraulic press.

31. Pull the piston partway out and squirt ethanol into the pressure cell (refer to Figure 1).

32. Remove the piston.

33. Initiate clean-up procedures and report any operational difficulties to the Fermentation Facility manager.

**Figure 3:** Schematic diagram of a French Pressure Cell. The arrow indicates the direction of force exerted on the piston by a hydraulic ram. Compressed fluid is prevented from escape by a rubber O-ring at the lower end of the piston.
Clean-up Procedures

1. Clean up the area around the press. **Note: The press will start to corrode if you leave spilled salt solutions around the work area.**

2. Autoclave the pressure cell, tubing and other materials that have come in contact with live microbial cells.

3. When you are done, you must carefully rinse out the pressure cell to prevent corrosion. **Note: The cell, although made of high-grade stainless steel, will corrode just like an ultracentrifuge rotor if not thoroughly cleaned.**

4. To clean the pressure cell, first disassemble the cell and rinse all pieces with warm tap water, followed by a distilled-water rinse. Be sure to run rinse water through the outlet stem and through the orifices of the cell itself. Cover the bottom of the cell and allow water to flow through the valve hole. Then, cover the bottom and the valve hole, allowing water to flow through the outlet hole (the hole on the right as the body of the cell stands upright).

5. Allow the pressure cell to air dry on paper towels or a drying rack.

6. Initiate check-out procedures by having the pressure cell and the surrounding work area inspected by the Fermentation Facility manager.

Machine Care and Maintenance

- The French Pressure Cell must be properly cleaned and inspected after each use.
- All inspections are performed by the Fermentation Facility manager.
- The French Pressure Cell should never be stored where the cell may corrode, e.g. where salt or other corrosive substances may be present. **Note: For long-term storage, store the cell with a thin oil coating, as per the manufacturer’s instructions.**

Accessories

None