IMPROVED PERFUSION CUM COMPRESSION BIOREACTOR SYSTEM FOR TISSUE ENGINEERING APPLICATIONS

IITM Technology Available for Licensing

PROBLEM STATEMENT

- **Bio-reactors** are systems where conditions are **closely controlled** to permit and induce a certain behavior in **living cells or tissues**.
- The system is provided with **controlled and steady flow** of growth media and factors necessary for cell growth where the **pH, temperature, pressure, nutrient supply and waste removal** is maintained at optimum conditions.
- Some of the **types of bioreactors** available are spinner flasks, rotating vessels, hollow fiber, perfusion bioreactors .
- The present invention is an **improved design of a perfusion cum compression** bio-reactor for creating tissue like **cartilage tissues.**

TECHNOLOGY CATEGORY/ MARKET

Category: Biotechnology & Genetic Engineering

Industry: Biomedical devices Manufacturing, Cell-Based Therapy Manufacturing, Vaccine Manufacturing

Application: Tissue engineering, Biomedical engineering applications and basic science studies.

Market: The global market size of Biotechnology & Genetic Engineering was valued at **USD 1.36 Billion in 2023** and projected to grow from **USD 1.68 Billion in 2024 to USD 7.73 Billion by 2032**, exhibiting a **(CAGR) of 20.94%** during the forecast period (2024 - 2032).

INTELLECTUAL PROPERTY

IITM IDF Ref. 1556; Patent No: IN 532512;

TRL (Technology Readiness Level)

TRL-4, Experimentally validated in Lab;

Research Lab

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TECHNOLOGY

Figure 1 shows a Assembled PCC Bioreactor chamber

- **Perfusion Cum Compression (PCC)** bioreactor chamber was designed and fabricated with the following parts.

1) Compression chamber,
2) Inflatable membrane O-ring,
3) Compression port, and
4) Lock plate.

1. Compression chamber

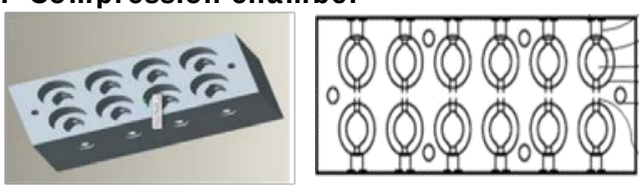

Figure 2 shows a compression chamber

- The **acrylic** compression chamber was **slotted** with **12 number** of grew in **two steps.**
- First slot have a larger diameter and the lower with smaller diameter which hold **cell seeded scaffolds/tissue explants.**
- The **first step** has a cylindrical slot with diameter of **21mm** and the **second step** has a diameter of **610mm Perpendicular** to the lower grew the orifice of medium perfusion was placed.
- The both ends of the orifice (towards and from the cell seeded scaffold/tissue explants side) **the curvature is increased** to make the **flow of medium uniform** and outer end is enabled for threaded luer connectors with **silicon O-rings**.
- Silicon rubber tubing connected to the luer of the chamber pass through a **peristaltic pump** and then to the growth media reservoir.

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2. Inflatable membrane O-ring

Figure 3 shows a Inflatable membrane O-ring

- The unique inflatable membrane **O-ring** is fabricated using **silicon-rubber**.
- The **one end is inflatable** with **compressed air** and the other provisions to act as O-ring which gets suited to **the larger surface diameter** slot in the compression chamber.
- The dimensions of the slots **vary with the cell seeded** scaffolds/tissue explants.

3. Compression port

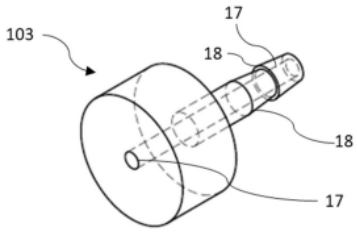

Figure 4 shows a Compression port
103- Compression port
17- Orifice of Compression port
18-Provision for connecting (barb) tubing

- The compression port (20mm Dia)was designed like an **inverted half head candle holder** made of **polypropylene or teflon or acrylic.**
- The broad end of the compression port gets suited **above** the Inflatable membrane O-ring.
- On the other end of the compression port, provisions are made for **connecting (barb) tubing** that supply compressed air.
- O-ring through the centre an **orifice of 3 mm** diameter was provisioned for supplying of compressed air.

4. Lock plate

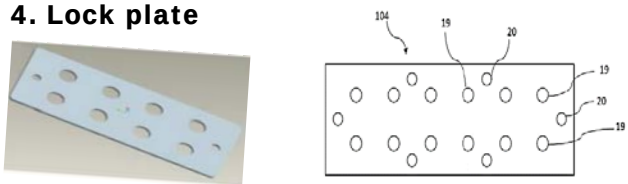

Figure 5 shows a Lock Plate
104-Lock plate
19-Access for compression port
20-Fasteners hole on plate

- **Lock plate (2mm thick**) is made of **stainless steel** to lock the bioreactor chamber assembly intact.
- **Two plates**, **one at the bottom** of the compression chamber and the **other was suited above.**
- Using stainless steel fasteners to lock plates were locked keep the assembly intact.

Key Features / Value Proposition

- ✓ Can be used for **biomechanical forces** like **dynamic or static compression loading, hydrostatic pressure**.
- ✓ Growth medium of perfusion may be **separately or in combination** on **cell seeded scaffolds/tissue explants** for tissue engineering applications.
- ✓ The **compression chamber of size ratio 30x60x180** is **slotted** with **12 cylindrical slots.**
- ✓ **Minimum loading time** of the cell seeded scaffolds **less than** that **5-10 minutes.**
- ✓ **Compact** and consists of members which have dual functions.
- ✓ **vivo microenvironment** by **controlling the amount and type of biomechanical forces.**
- ✓ **Improved** bio-reactor for generating tissues like **neo-cartilaginous tissues, bone tissue, liver tissues** etc.
- ✓ **Easy to assemble, disassemble**.

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