

# **Fibre-Powder Composite As Core Material For Vacuum Insulation Panel**

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# Presentation Outline

- Why Vacuum Insulation Panel (VIP)?
- Core Materials for Vacuum Insulation Panel.
- Fibre-Powder Composites as Materials.
- Conclusions.

# Million Tonnes Oil Equivalent

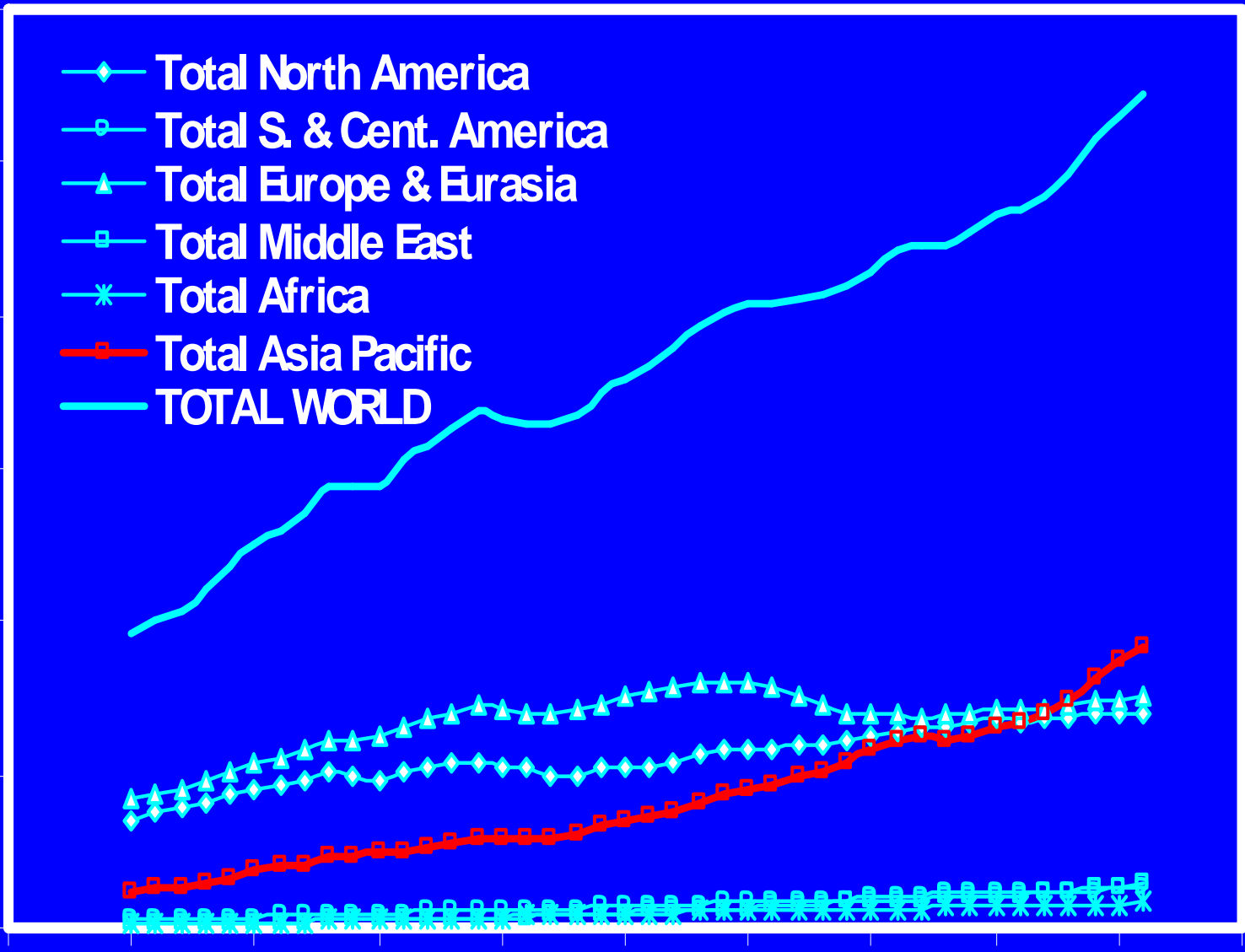
12000  
10000  
8000  
6000  
4000  
2000  
0

- ◆ Total North America
- ◻ Total S. & Cent. America
- ▲ Total Europe & Eurasia
- ◻ Total Middle East
- \* Total Africa
- ◻ Total Asia Pacific
- TOTAL WORLD

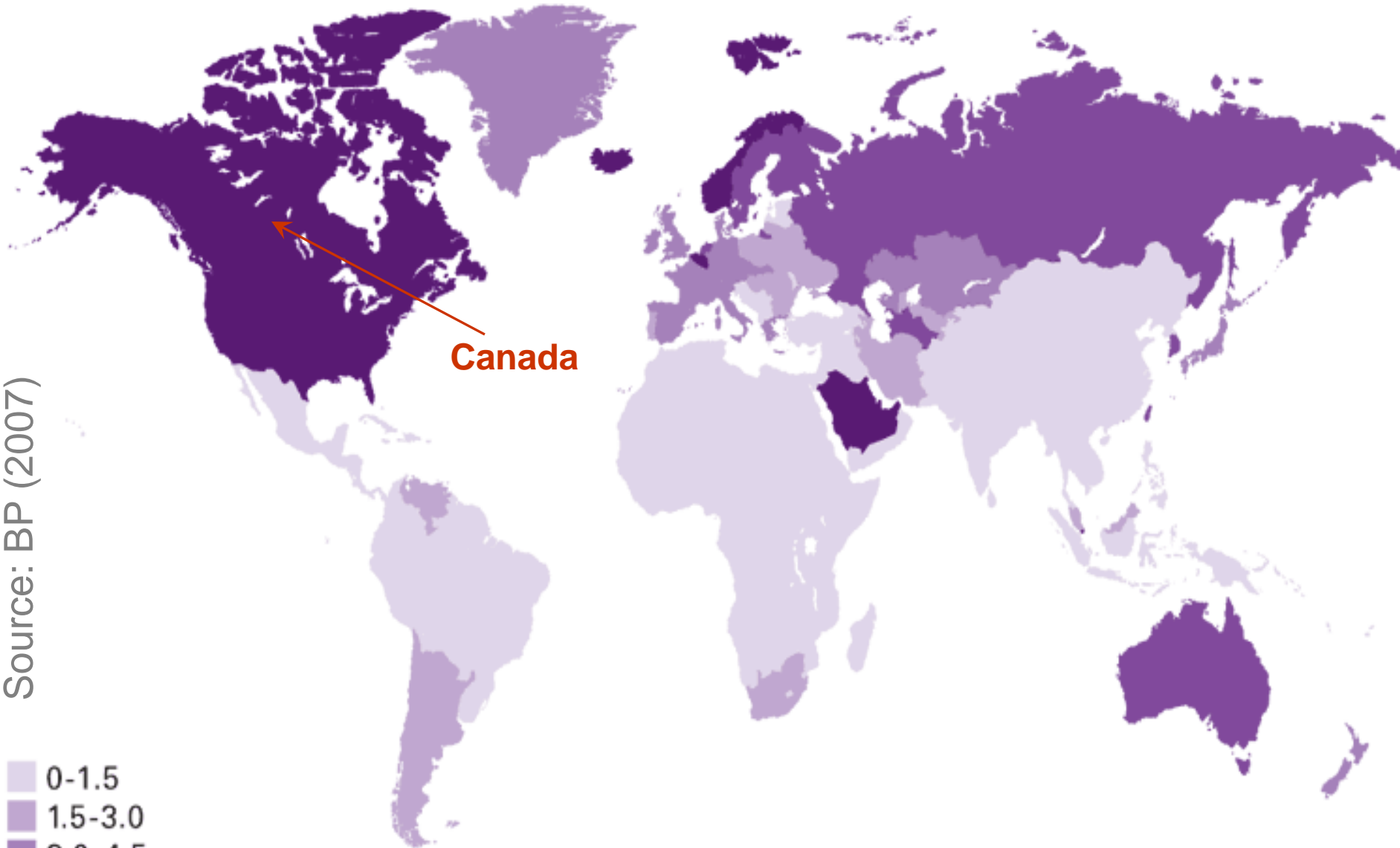
1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010

Year

Source: BP (2007).

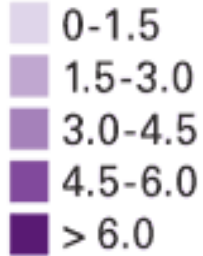


Consumption per capita 2006  
Tonnes oil equivalent



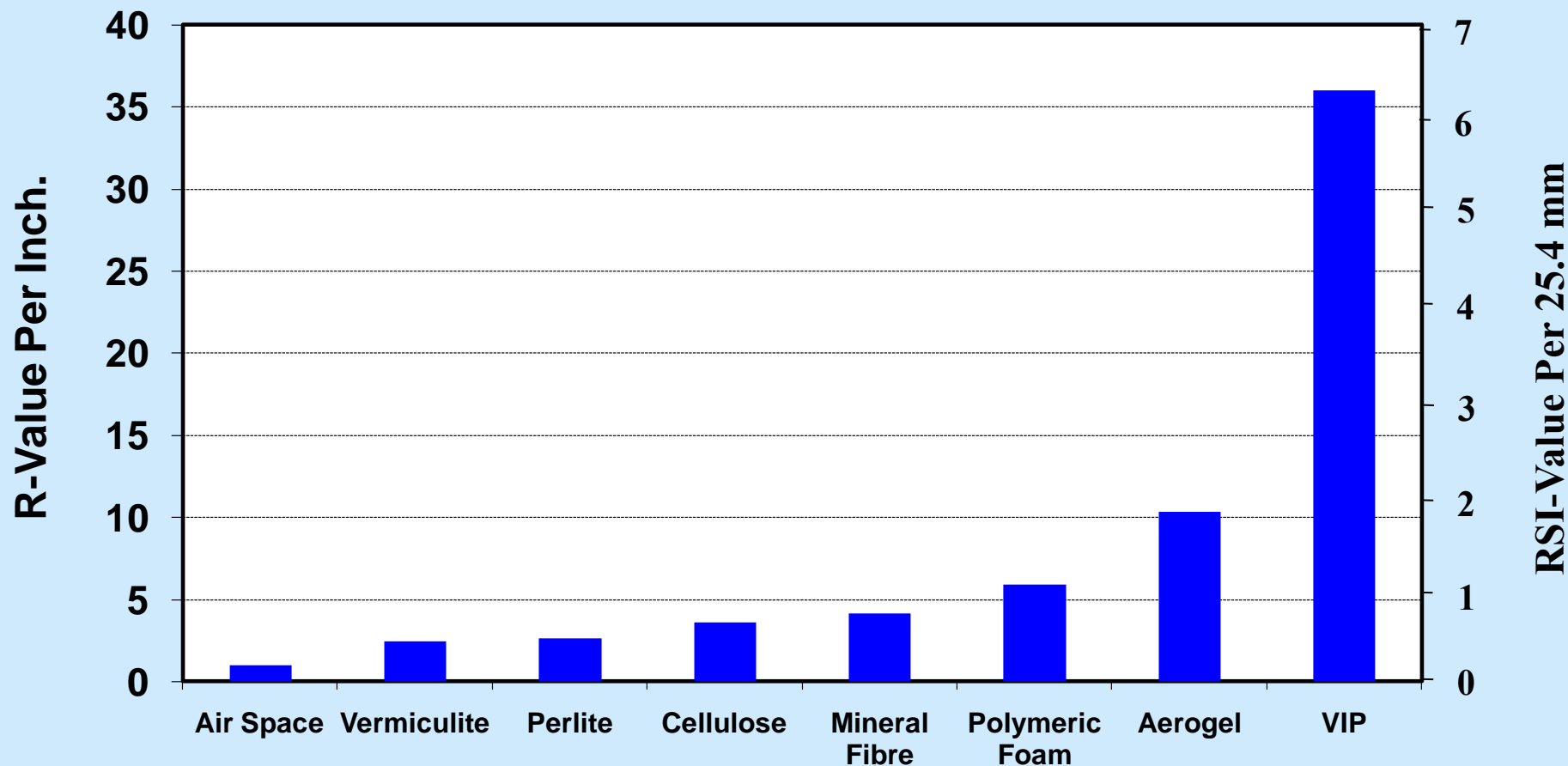
Canada

Source: BP (2007)

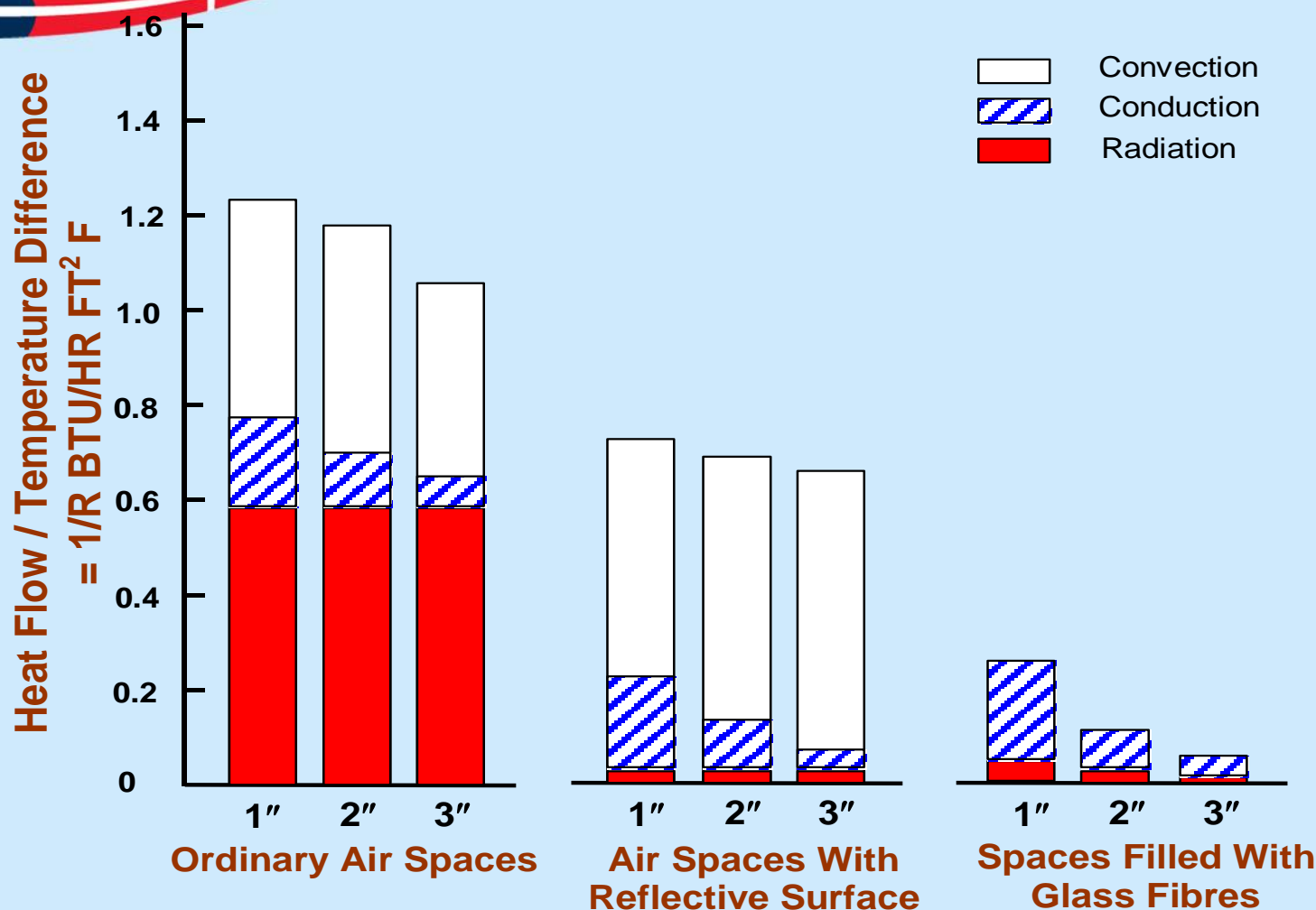


- Fossil Fuel Consumption Driven Economic Growth
- 30% of the Total Energy is Consumed by Buildings

# Thermal Performance of Various Insulation



# Heat Transfer Mechanisms

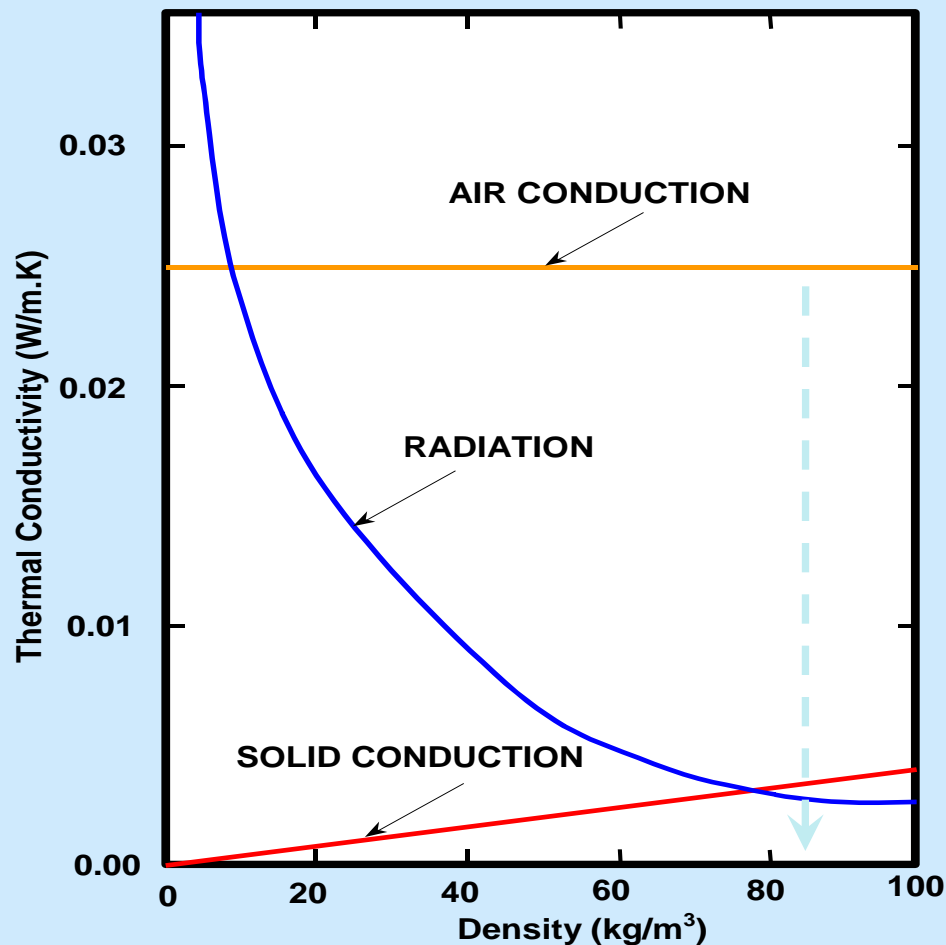


CBD – 149; Shirtliffe

**Heat Transfer Across Air Spaces –  
Contribution by Radiation, Conduction and Convection**

# Heat Transfer Mechanisms

## ➤ VIP: Air Conductivity Component $\approx$ Zero

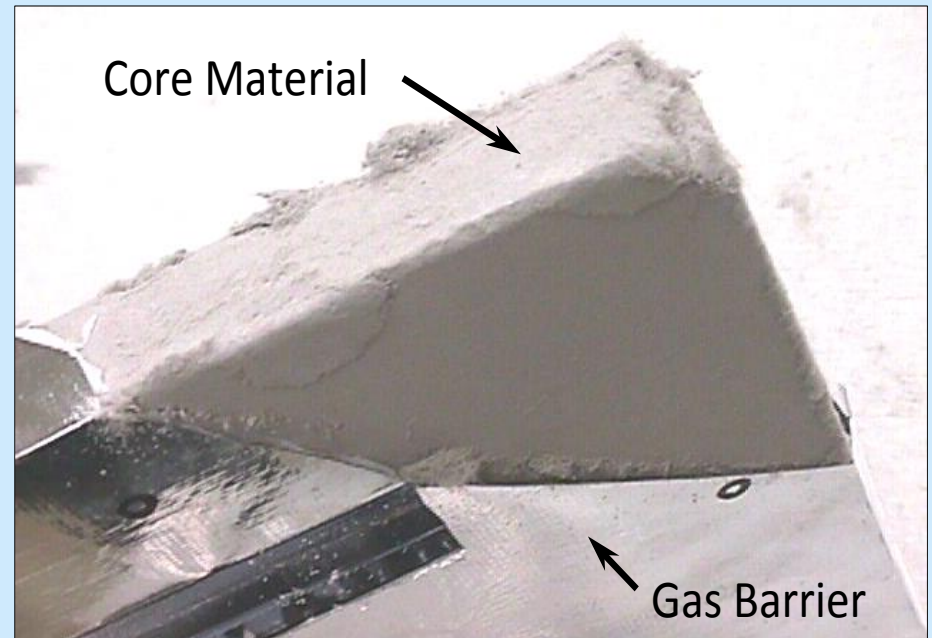


# Vacuum Insulation Panel (VIP)

Getter / Desiccant

**Core Material**

Gas Barrier / Facer Foil

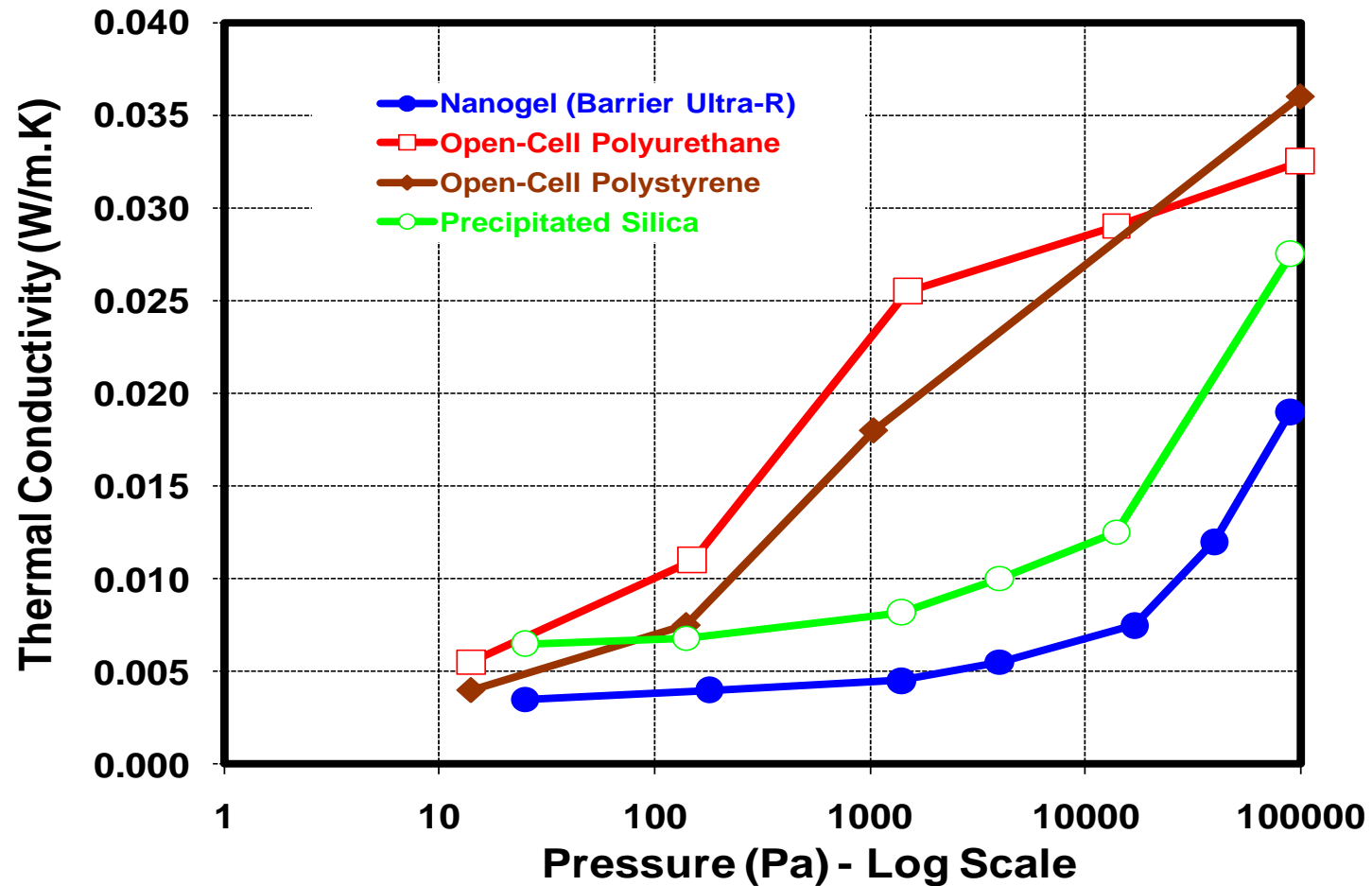




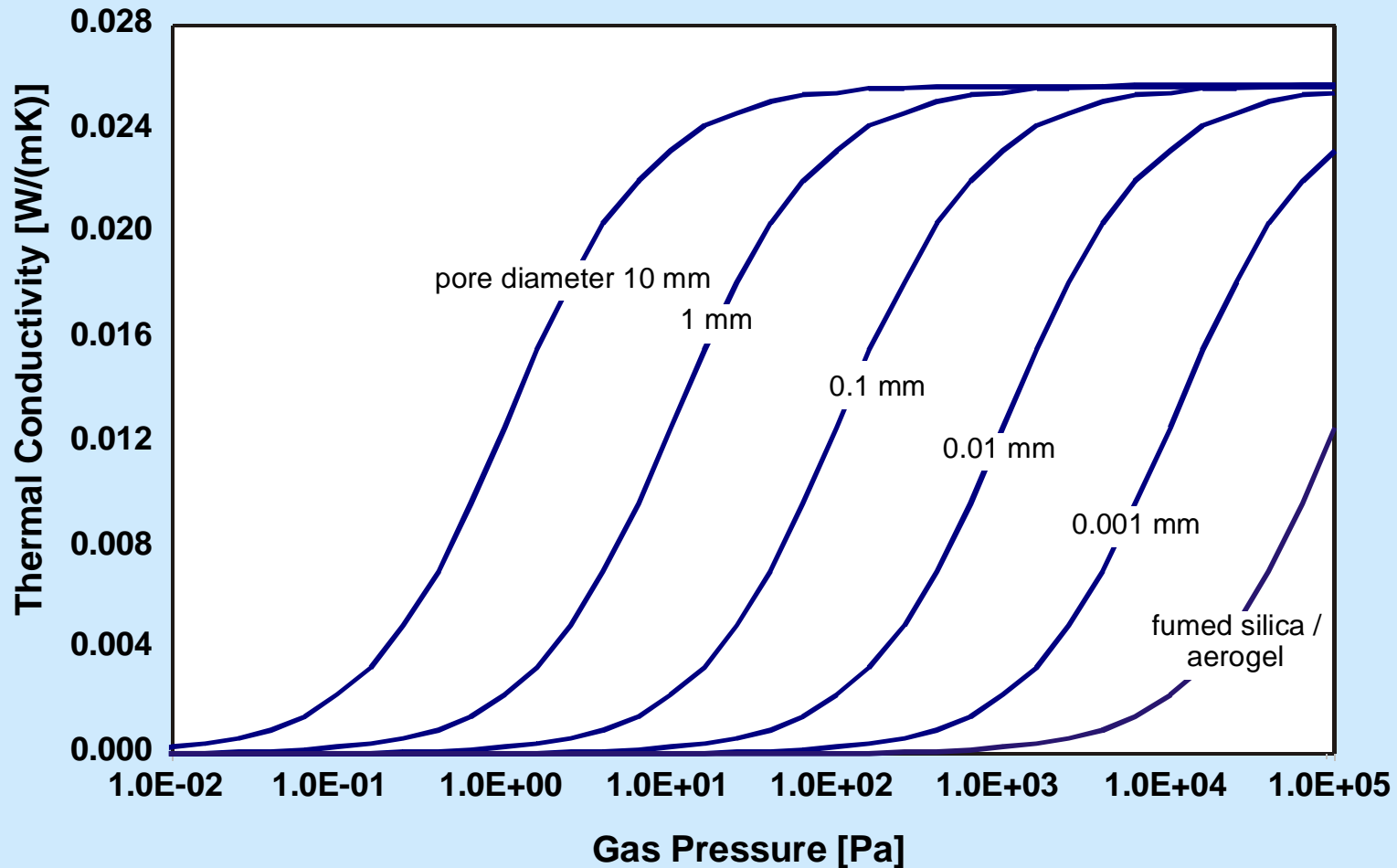
# Vacuum Insulation Panel (VIP)

1. **Core Material** - imparts mechanical strength and thermal insulating capacity.
2. **Gas Barrier / Facer Foil** - provides air and vapour tight enclosure for core material.
3. **Getter / Desiccant** - adsorbs residual or permeating atmospheric gases or water vapour in the VIP enclosure.

# Thermal Conductivity of Core Materials



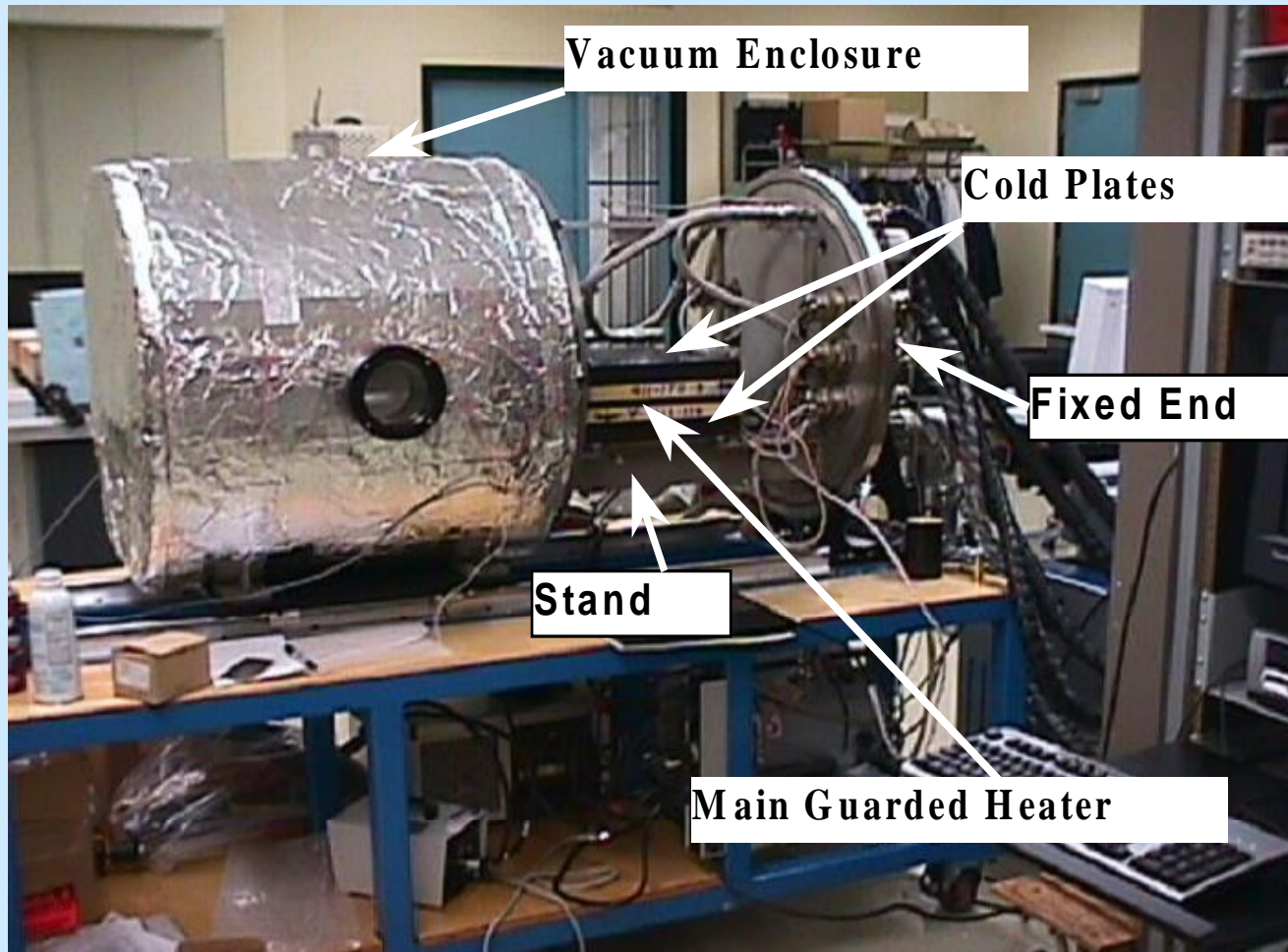
# Thermal Conductivity of Core Material



## **Core Materials for VIP**

- Precipitated silica, fumed silica, nanogel (silica aerogel) are used as core materials.
- Core materials are expensive.
- Alternative core materials can reduce the cost of VIP.

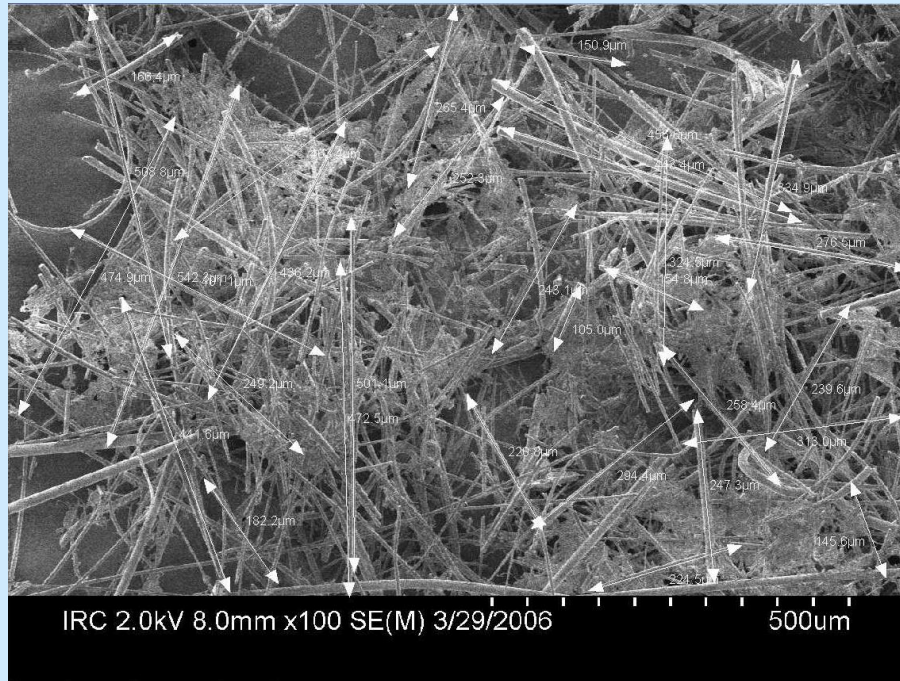
# Vacuum Guarded Hot Plate (VGHP)



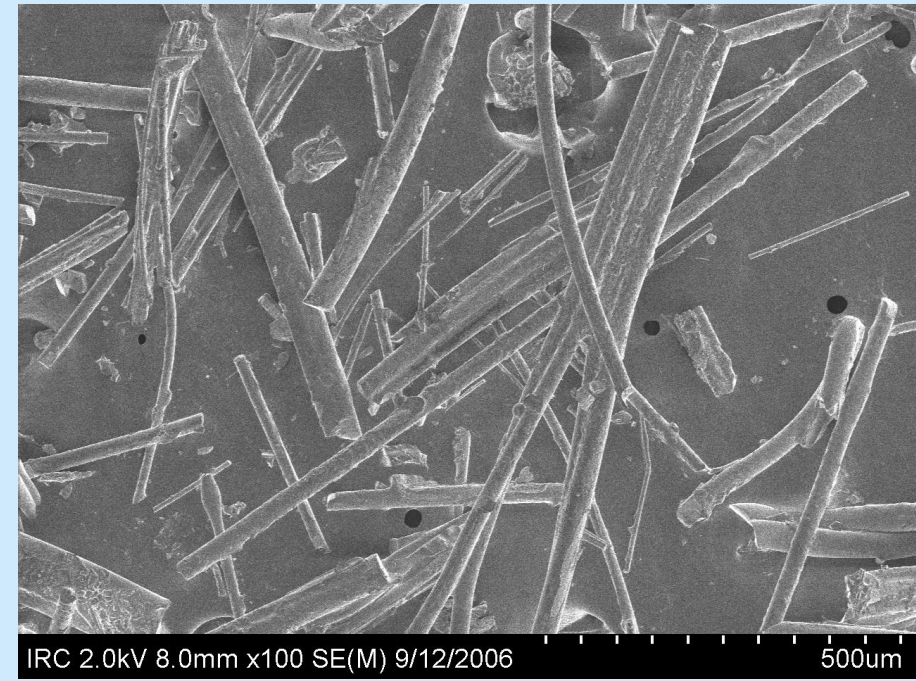
**VGHP Operation**



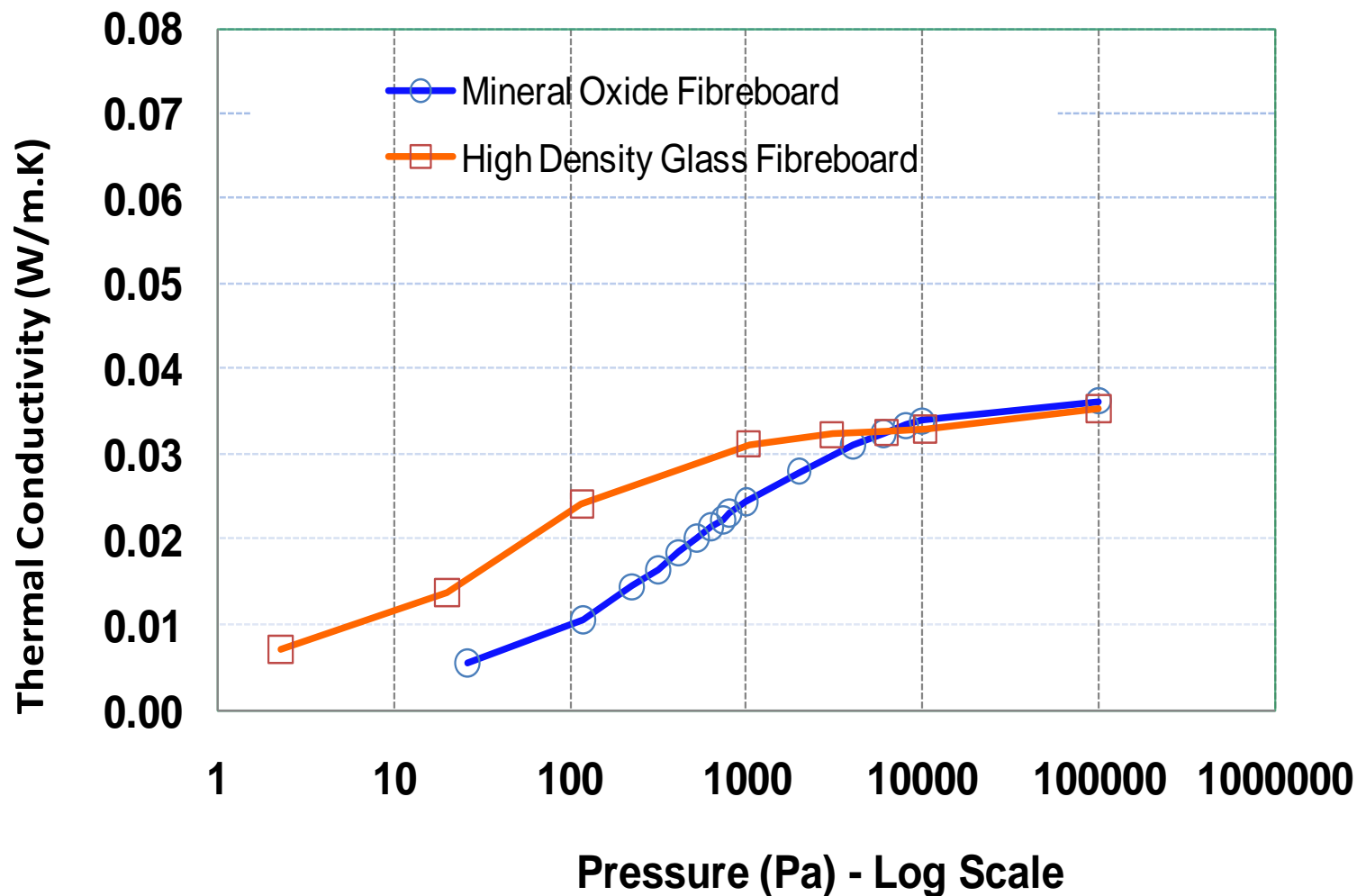
# Fibre Core Materials



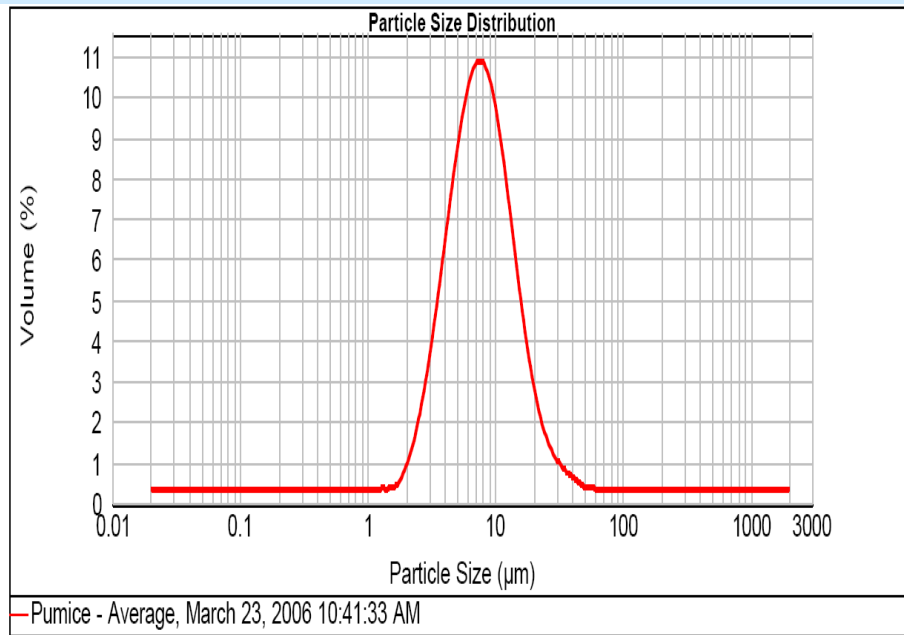
Mineral Oxide Fibre Board (MOFB)



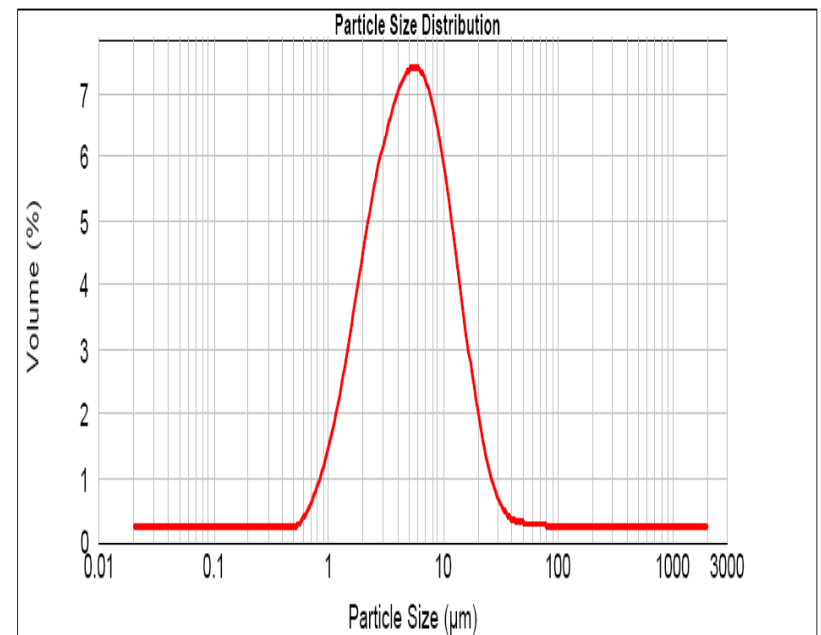
High Density Glass Fibre (HDGF)



# Powder Core Materials



Pumice

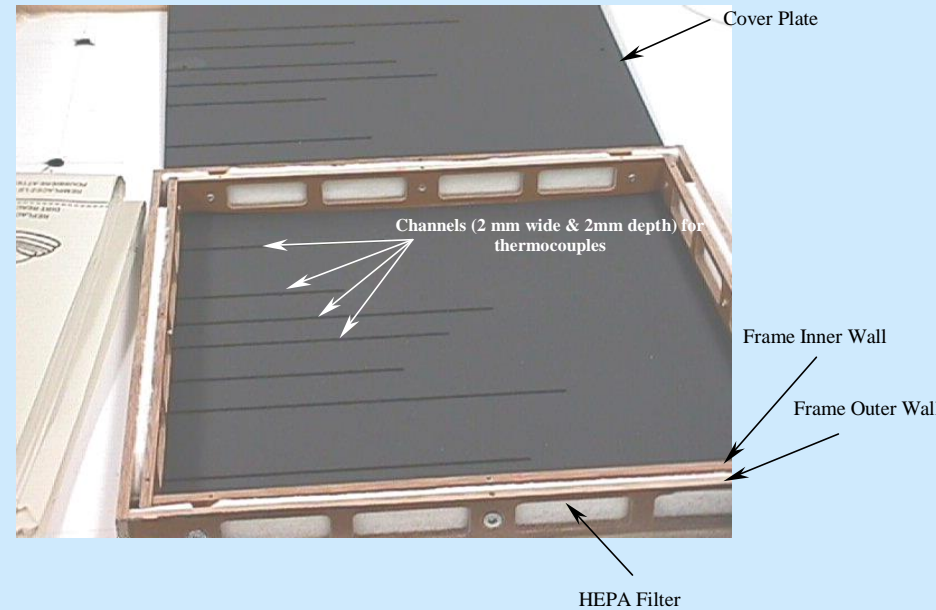
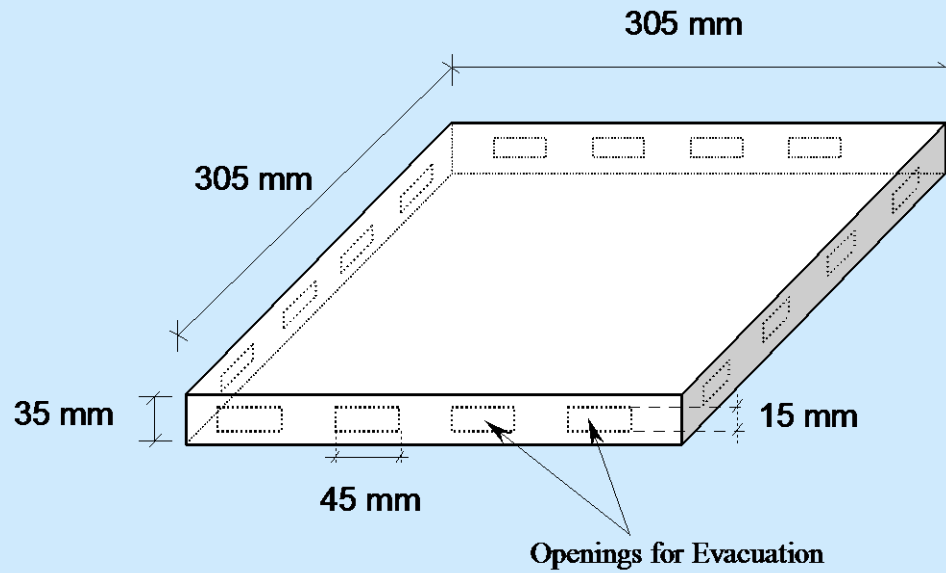


Zeolite

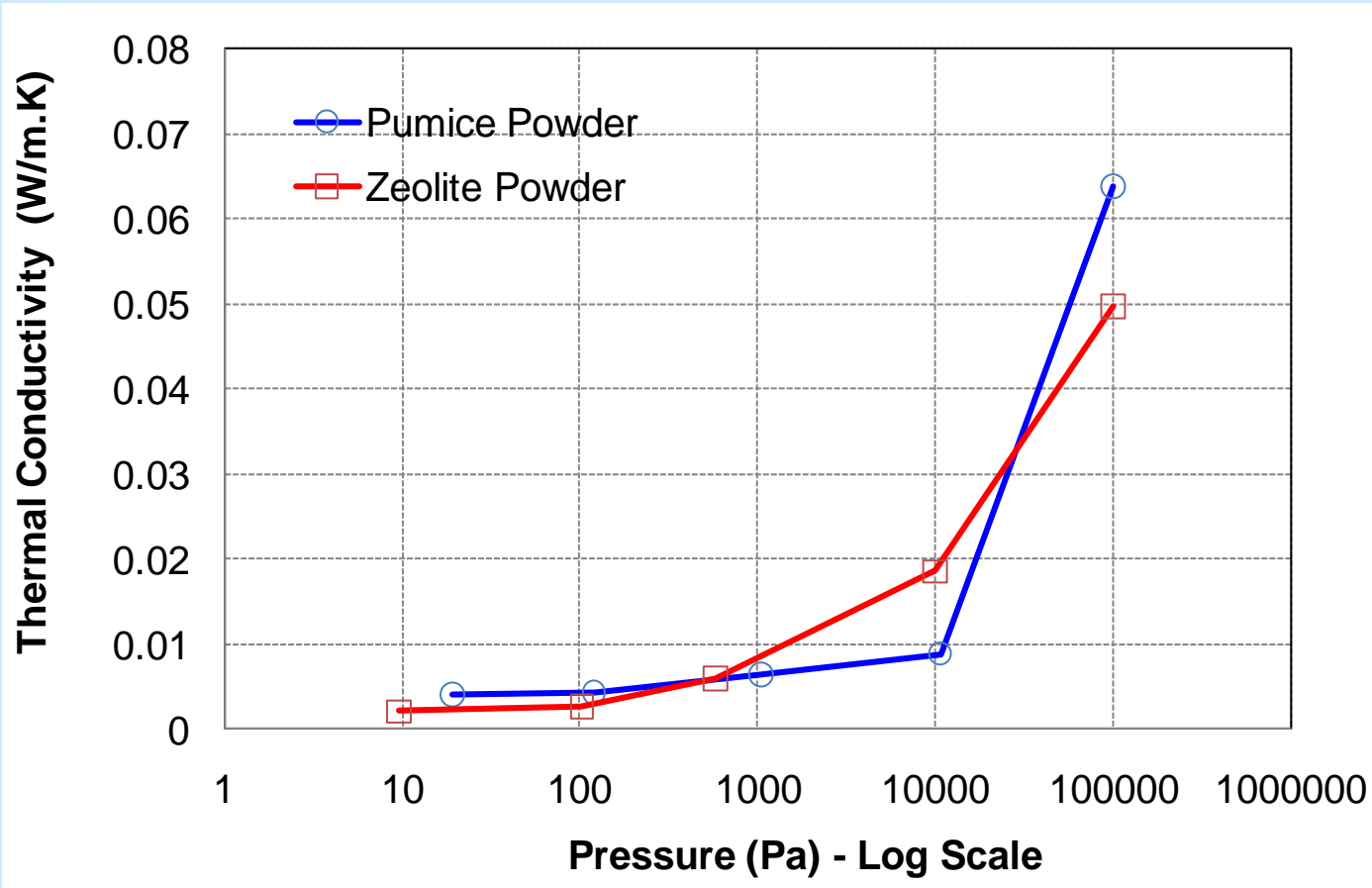
**Particle Size Analysis – Output from Particle Analyzer**



# Powder Evacuation Box

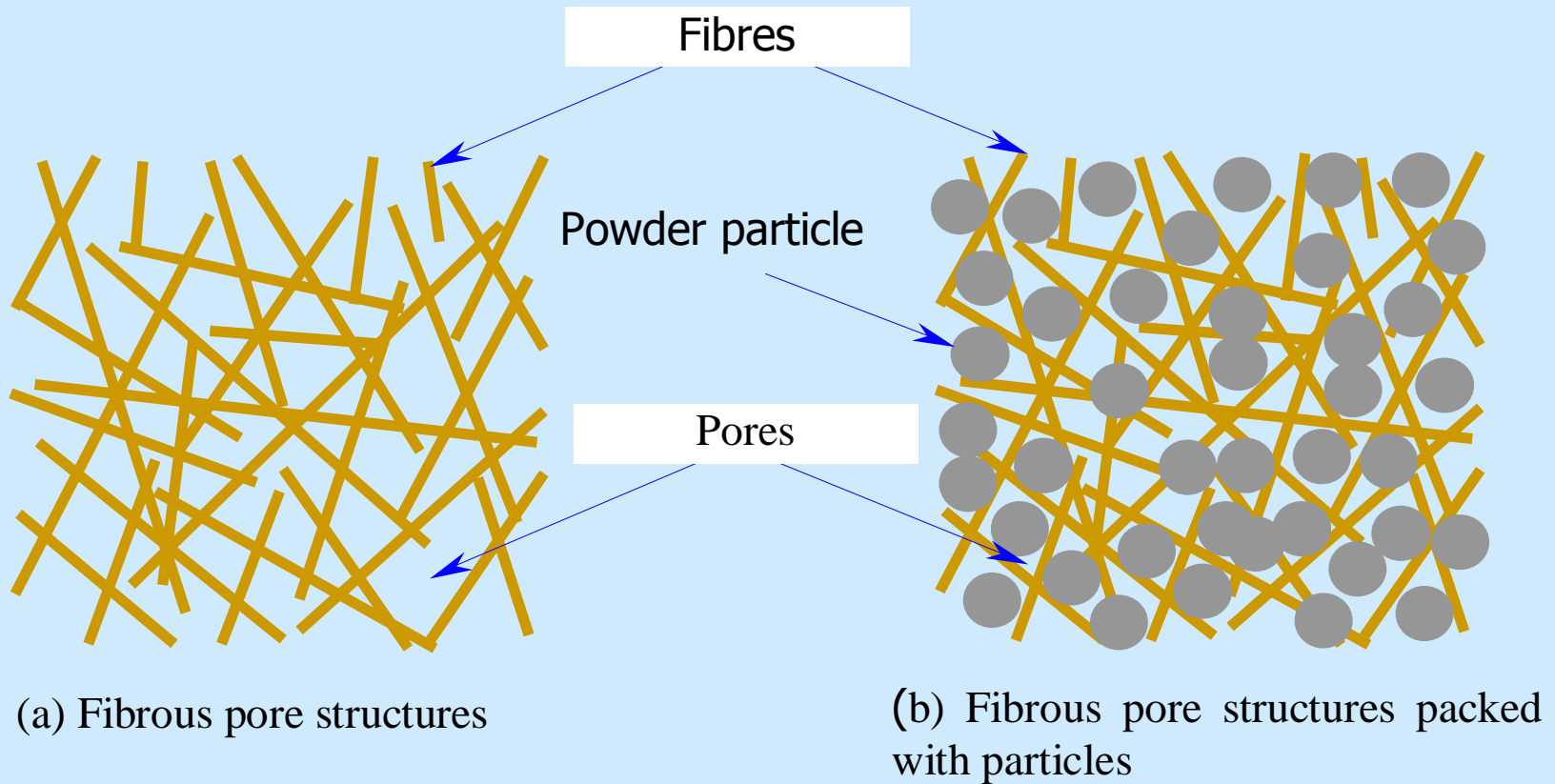


# Powder Core Materials



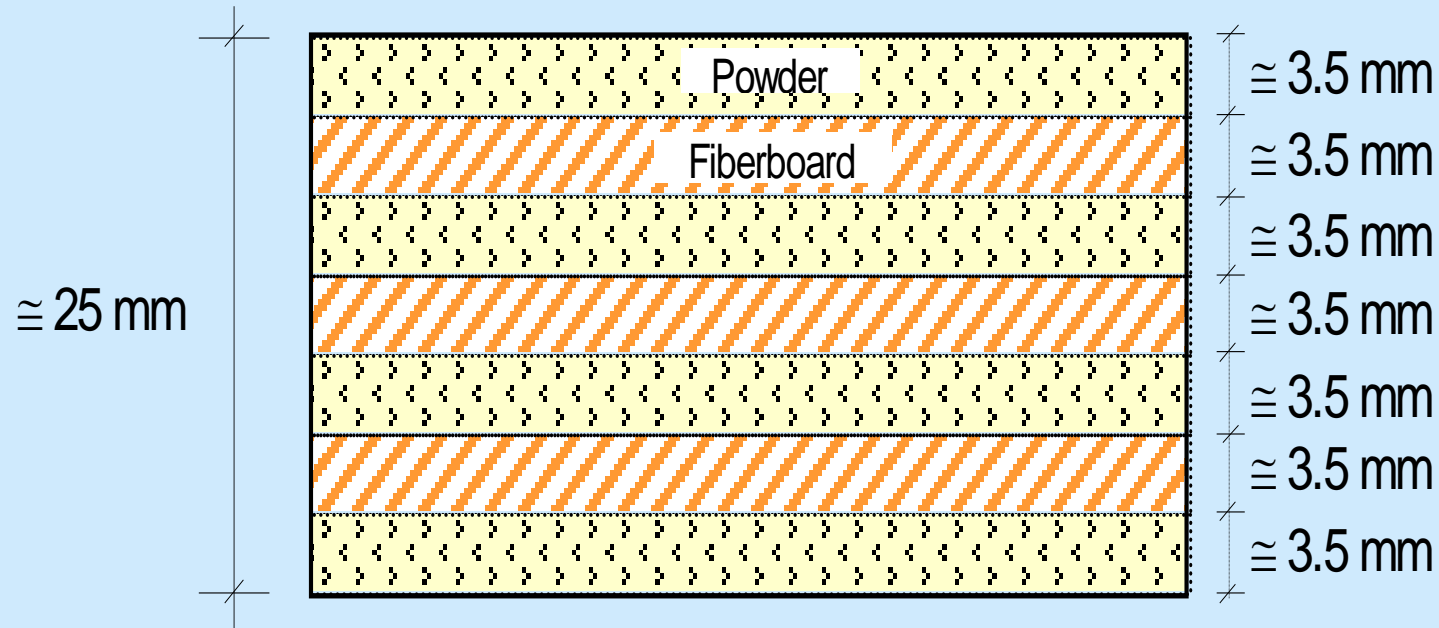
## Thermal Characteristics of Pumice & Zeolite Powders

# Alternative Nano-Porous Core Materials

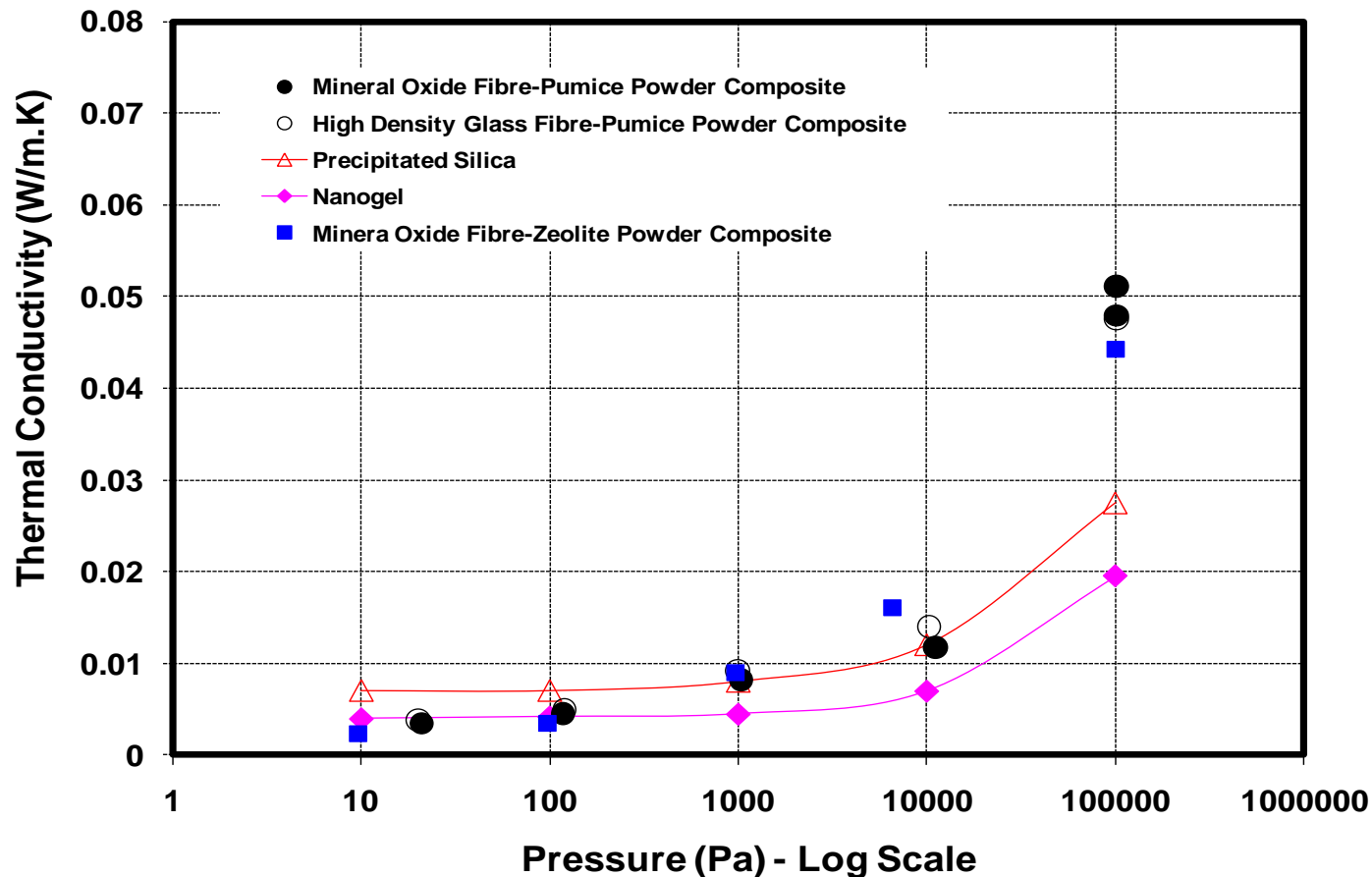


## Basic Hypothesis of Fibre-Powder Composite

# Alternative Nano-Porous Core Materials

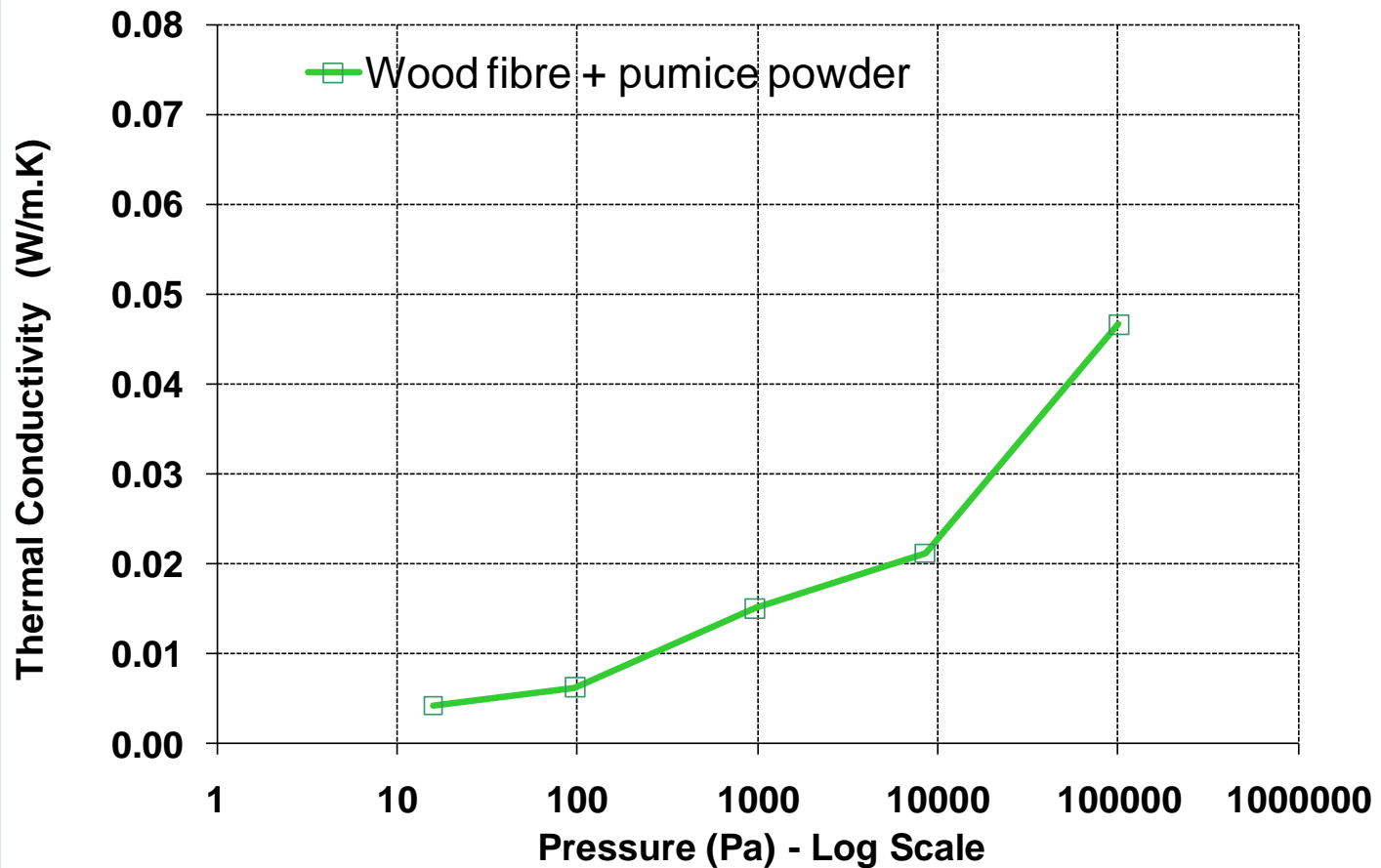


## Basic Hypothesis of Fibre-Powder Composite



**Comparison of Thermal Characteristics –  
New/Alternative Core Materials vs. Nanogel and Precipitated Silica**

# Wood Fibre-Powder Core Materials



# Conclusions

1. Use of vacuum insulation panel (VIP) is the need of the hour for the Canadian/Global construction industry.
2. Fibre-powder composite can be used to produce VIP with thermal insulating properties comparable with the VIP made with nanogel or precipitated silica.
3. Use of wood-fibres for the construction of VIP is a real possibility and should be explored further for the development of bio-based VIP.



# Insulation and Building Materials Laboratory (IBML)

## Measurement to Innovation

### Focus Areas

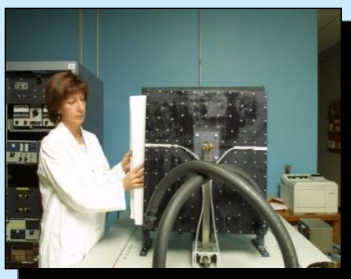
- # Thermal and Moisture Performance Assessment of Insulation and Building Materials.
- # National Thermal Measurement Calibration Laboratory.
- # Research Support to CCMC and CCC.
- # Development of Standard Test Methods.
- # Analytical Techniques for Thermal and Moisture Transport Process.
- # Maintain and Enhance Unique Hygrothermal Material Property Database.
- # Research on Innovative Building Materials.



*Heat Flow Meter –  
Thermal Conductivity*



*Vacuum Guarded Hot  
Plate –  
Thermal Conductivity*



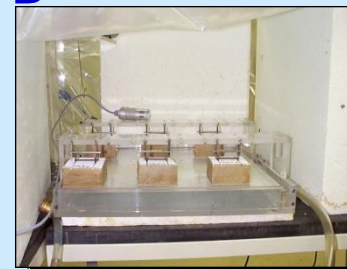
*Guarded Hot Plate –  
Thermal Conductivity*



*Pressure Plate Apparatus –  
Desorption Isotherm*



*Air Permeability Apparatus  
–  
Air Permeability*



*Partial Immersion –  
Water Absorption  
Coefficient*



*Sorption / Desorption  
Measurement –  
Sorption / Desorption Isotherm*



*Constant Temperature and  
Humidity  
Chambers – Water Vapour  
Diffusion*





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# Science —at work for— Canada



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