Contents

Acknowledgement iv
List of Figures xi
List of Tables xvi

Chapter 1 Introduction

1. Introduction 01
   1.1. Sensors 01
   1.2. Basic Sensor Domains 02
   1.3. Mechanical Domain Sensors 02
      1.3.1. Weighing (Force) sensor 03
         1.3.1.1. Measurement of Force and Mass 04
            1.3.1.1.1. Direct Comparison Method 04
            1.3.1.1.2. Indirect Comparison Method 05
         1.3.1.2. Force Balance Technique 06
         1.3.1.3. Load Cell 07
            1.3.1.3.1. Hydraulic 07
            1.3.1.3.2. Pneumatic 08
            1.3.1.3.3. Piezoelectric 08
            1.3.1.3.4. Magneto elastic 08
            1.3.1.3.5. Strain Gauge 09
               1.3.1.3.5.1. Wire Type 09
               1.3.1.3.5.2. Unbounded Type 09
               1.3.1.3.5.3. Semiconductor Type 10
               1.3.1.3.5.4. Foil Type 10
         1.3.1.3.6. Overview of Weighing/Force Sensors 11
      1.3.2. Liquid Level Sensor 11
         1.3.2.1. Material Characteristics and Limitations 11
         1.3.2.2. Level Sensors 12
            1.3.2.2.1. RF Capacitance 12
1.7.1. Microbend Weighing (MBW) Sensor
1.7.2. Archimedes Principle Liquid Level (APLL) Sensor
1.7.3. Hotwire Gas Flow (HWGF) Sensor (With Base)
References

Chapter 2 Microbend Weighing (MBW) Sensor

2.0 Introduction
2.1. Plastic Optical Fiber
   2.1.1. Optical Fibers Vs Plastic Optical Fiber
      2.1.1.1. Types of Optical Fiber
   2.1.2. Loss Mechanisms in Fibers
      2.1.2.1. Material Absorption
      2.1.2.2. Material Scattering
      2.1.2.3. Light Guide Specific Scattering Mechanisms
      2.1.2.4. Fiber Coupling Loss
      2.1.2.5. Radiation Losses due to Macrobending
      2.1.2.6. Losses due to Microbending
   2.2. Optical Fiber Sensors (A General Review)
      2.2.1. Classification of Optical Fiber Sensors
         2.2.1.1. Classification by Type
         2.2.1.2. Classification by Operating Principle
         2.2.1.3. Summary of Fiber Optic Sensors
      2.2.2. Advantages of Fiber Optic Sensors
      2.2.3. Intrinsic Fiber Optic Sensors
         2.2.3.1. Review of Microbend Sensor
2.3. MBW Sensor: Design Consideration
   2.3.1. Balance Structure
   2.3.2. Pair of Deforming Plates
   2.3.3. Plastic Optical Fiber
   2.3.4. Optical Transmitter – Receiver
      2.3.4.1. Plastic Fiber Optic Transmitter Diode
      2.3.4.2. Plastic Fiber Optic Phototransistor Detector
   2.3.5. Electronics for MBW Balance

vii
Chapter 3  Archimedes Principle Liquid Level (APLL) Sensor

3.0 Introduction

3.1. Archimedes Principle
   3.1.1. Specific Gravity and Density
   3.1.2. Hydrostatic Pressure
   3.1.3. Overview of Level Measurement

3.2. APLL Sensor Design Considerations
   3.2.1. Operating Principle and Sensor Assembly
   3.2.2. Design of the Rod
   3.2.3. Selection of the Load cell
   3.2.4. Stilling well (Protecting tube)
   3.2.5. Electronic Level Indicator
      3.2.5.1. Power On Sequence
      3.2.5.2. Initial Setup

3.3. Experimentation
   3.3.1. Calibration
      3.3.1.1. Online calibration
      3.3.1.2. Off line calibration

3.4. Results
3.5. Discussion
3.6. APLL Sensor Specifications
Chapter 4  Hotwire Gas Flow (HWGF) Sensor (With Base)

4.0 Introduction  

4.1. Review of Hot wire Anemometry  
4.1.1. Hot-wire Sensors  
4.1.2. Hot-film Sensors  
4.1.3. Shape of the Probes  
4.1.4. Linearization  
4.1.5. Constant Current Anemometer  
4.1.6. Constant Temperature Anemometer  
4.1.7. Comparison of Anemometer systems  
4.1.8. Applications  

4.2. Hot Wire Gas Flow (HWGF) Sensor Fabrication  
4.2.1. HWGF Sensor on Ferrite base material  
4.2.2. HWGF Sensor on Alumina substrate  
4.2.3. Bridge Circuit  

4.3. Characterization  

4.4. Results  

4.5. Discussion  

4.6. HWGF Sensor Specifications  

4.7. Conclusions  

References  

Chapter 5  Simulation and Analysis  

5. Introduction  

5.1. Microbend Weighing Sensor Simulation  
5.1.1. Simulation tool  
5.1.1.1.Processes in Evaluation Software ANSYS (V 8.0)  
5.1.1.2. Processing Parameters  
5.1.1.3. Inputs for Solution  
5.1.1.4. Post Processing Output (Results)  

References
Chapter 6 Summary and Future Scope

6.1. MBW sensor.

6.1.1. MBW Sensor Future Scope

6.2. APLL Sensor

6.2.1. APLL Sensor Future Scope

6.3. HWGF Sensor

6.3.1. HWGF Sensor Future Scope

LIST OF PUBLICATIONS