DESIGN AND DEVELOPMENT OF AIR PERMEABILITY TESTER

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BONAFIDE CERTIFICATE

Certified that this project report titled **"DESIGN AND DEVELOPMENT OF AIR PERMEABILITY TESTER"** is the bonafide work of Mr.G.Karthikeyan who carried out the research under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form part of any other project report or dissertation on the basis of which a degree of award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

A new method and Instrument is designed and development for air permeability testing of textile fabrics, especially in light and medium weight fabrics. This new method provides much more representative test results as the commonly used air permeability test. The results showed very good correlation with Air Permeability of fabric tested using KES-F8-AP1 Air-Permeability tester ($r = +0.961$). The effect of PPI on Air Permeability measured in DAP Air Permeability Tester showed than an increase in PPI decreased the Air Permeability. The effect of weave on Air Permeability showed that plain woven cloth had higher Air Permeability value.

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CHAPTER 1

INTRODUCTION

Testing is the application of engineering knowledge and science to the measurement of the properties of textile fibre, yarns and fabrics. It involves the use of techniques, tools, and instruments in the Laboratory for the evaluation of the properties of these different forms of textiles.

Testing has attained an important position in the textile industry. It is just as applicable to the analysis of a finished fabric, it is as useful for the measure of a household fabric as for any army fabric, and it is as necessary to controlling the quality of product.

In testing Air Permeability is one of the most important properties of the textile fabrics; it is necessary to control this fabric property both accurately and regularly. Air Permeability can be defined as the rate of airflow under a differential pressure between the two fabric surfaces.

The movement of air through a fabric can influence its suitability for many endues applications, including its effectiveness in combating wind chill, permitting the free escape of perspiration, or acting as a filter fabric. Therefore direct measurement of air, which is coming out of the fabric, is required to study the exact air permeability character of the fabric. Thus air permeability can directly influence both comfort.

Hence we focused our attention on the "DESIGN AND DEVELOPMENT OF AIR PERMEABILITY TESTER".

The success of this project aims to develop the air permeability tester also to make precise and speedy measurement of air permeability of textile fabrics especially in light and medium weight fabrics.

CHAPTER 2

LITERATURE SURVEY

The quality of the fabric for clothing depends to a great extent on aesthetic appeal, transport of air and moisture and other wear related properties. Due to the manner in which yarns and fabrics are constructed, a large proportion of the total volume occupied by a fabric is, in fact, air space. The distribution of this air space influences a number of important fabric properties such as warmth and protection against wind and rain in clothing, and efficiency of filtration in industrial cloths. A common example, vacuum cleaner bag is considered; the fabric must allow air to pass through but at the same time prevent the passage of dust and dirt.

2.1 Air Permeability and Fabric Properties

Air permeability is an important factor in the performance of textile materials such as gas filter, fabrics for clothing, mosquito netting, parachutes, sails, tentags, and vacuum cleaners. For example, in filtration, air permeability is directly related to efficiency. Air permeability can also be used to provide an indication of the breathability of weather and rainproof fabrics or of coated fabrics.

Construction factors and finishing techniques can have an effect upon air permeability by causing a change in the length of airflow paths through a fabric. Hot calendaring can be to flatten yarns, which reduces air permeability. Fabrics with different surface textures on either side can have a different air permeability depending upon the direction of airflow.

For a woven fabric, yarn twists us also important. As twist increase, the yarn diameter and the cover factor are decreased. This increase air permeability. Increase yarn twist may also allow the more circular, high-density yarns to be packed closely together in a tightly woven structure with reduced air permeability.

Yarn crimp and weave influence the shape and area of the interstices between the yarns and may permit yarns to extend easily. Such yarn extension would open up the fabric, increase the free area and increase the air permeability. (ASTM 1997)

2.2 Parameter Affecting Air Permeability

Many variables affect the fabric Permeability. Fabric Permeability depends on the area of fabric pores and the area covered by individual threads. Air permeability depends on the shape and value of the inter-thread channels, which are dependent on the weave and structural parameter of the fabric, between them on the threads cross section. (John1987,Stanley backer 1951,2002 Rimvydas Milasius)

Following parameter affecting the Air permeability

- Fiber
    - Type of fiber
    - Fiber Denier
    - Filament size
    - Fiber swelling
- Yarn
    - TPI
    - Strength
    - Yarn type
    - Yarn size
    - Yarn swelling
- Fabric
    - Type of weave
    - Cover factor
    - Tension
    - Porosity

- Velocity of air flow
- Relative humidity
- Temperature
- Finishing process
- Laundering process

2.3 Existing Air Permeability Tester

A knowledge of the air permeability of a fabric is useful in assessing its value as clothing material. This is fairly easily measured and a simple apparatus developed by Marsh Fig.2.1

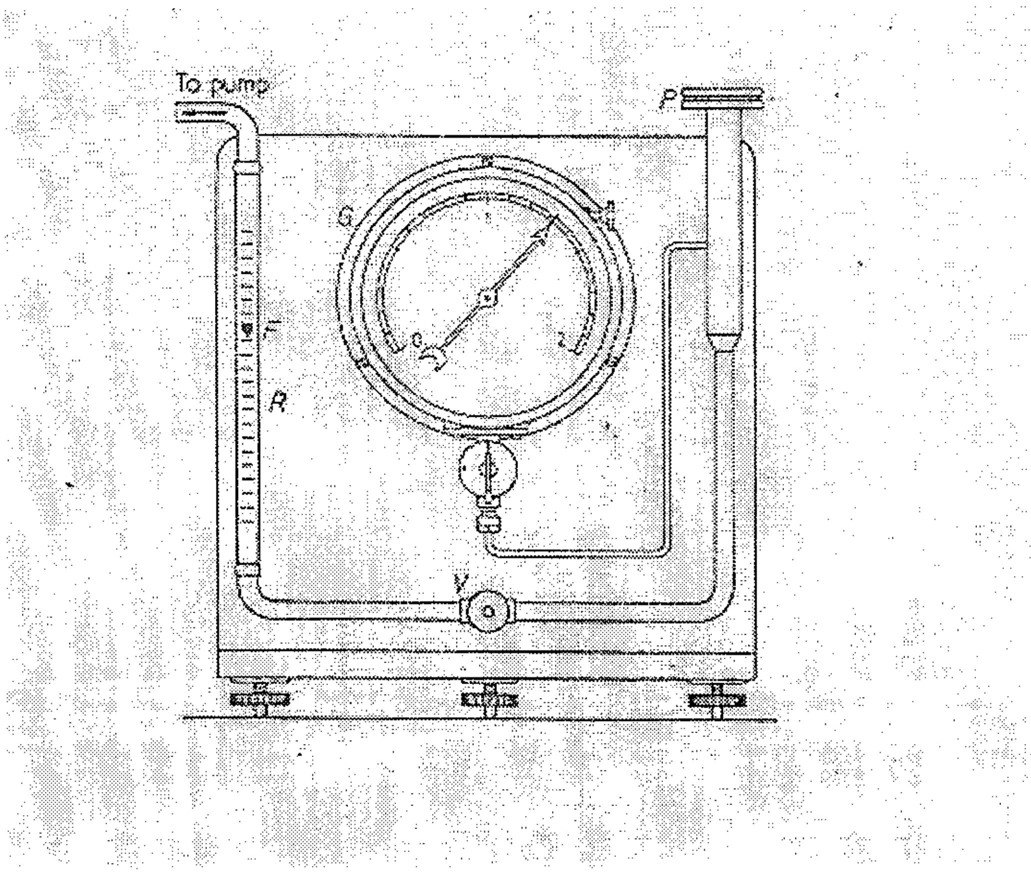


FIG.2.1 A Simple Air-Permeability Apparatus

The sample is clamped across an orifice and air is drawn through it by means of a pump. The rate of flow is measured by a rotameter airflow meter and the pressure drop across the sample by the draught gauge. It will be obtains a linear relationship between pressure drop and air flow for air speeds below about 40 ft/min. generally the pressure drop for a flow of nearly 40 ft/min through the sample is measured and the permeability expressed as flow per unit area per unit pressure difference. For accuracy the tests are made in an air-conditional room, the samples having previously been conditioned for 24 h, for air permeability is affected by humidity.

Clayton has also measured the air permeability of fabrics using the apparatus shown in Fig2.2

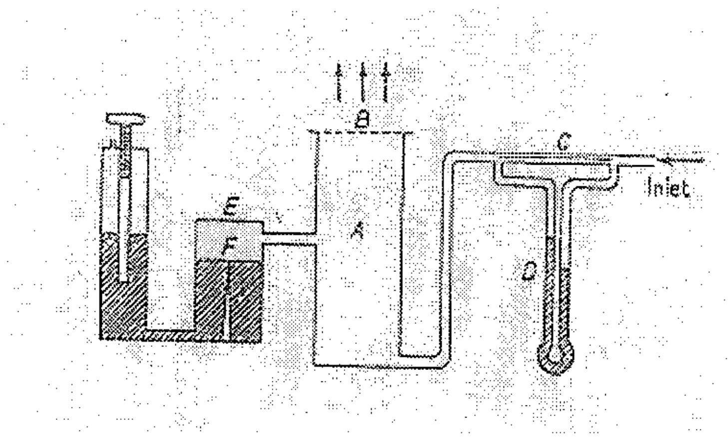


FIG.2.2 Fabric Air-Permeability Apparatus

The fabric is clamped across the end of cylinder A. The air-pressure difference across the sample is measured by the mercury manometer and the air flow by measuring the pressure fall across calibrated capillaries, a range of these of varying bore being used. The air was conditioned by passing through saturated ammonium nitrate solution and the whole apparatus and samples maintained at constant temperature and humidity in a cabinet.

A specimen of fabric placed in the holder of device for measuring air permeability can be regarded as constituting a porous plug, and provided the fibres are uniformly distributed the air flow can be calculated.

The TEXTEST Instruments Company, to develop the air permeability Tester. Textest Air Permeability FX3300 tester Fig. 2.3, this instrument works automatically and digitally.

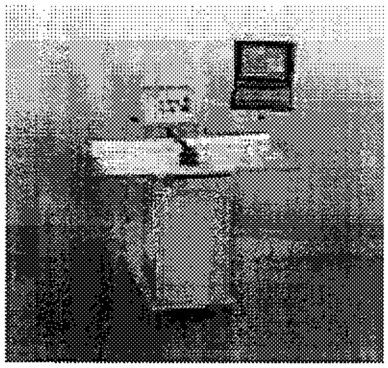


FIG.2. 3 Fx3300 Air Permeability Tester

A powerful, muffed vacuum pump draws air through an interchangeable test head with a circular opening. For measurement the test head appropriate for the selected test standard is mounted to the instrument. The specimen is clamped over the test head opening by pressing down the clamping arm, which automatically starts the vacuum pump. The pre-selected test pressure is automatically maintained, and after a few seconds the air permeability of the test specimen is digitally displayed in the pre-selected unit of measure. By pressing down the clamping arm a second time the test specimen is released and the vacuum pump is shut off.

The test pressure is digitally pre-selected is accordance with the test standard. It is automatically controlled and maintained by the instrument. Due to a true differential measurement the test pressure is measured accurately even at high airflow rates.

The airflow through the test specimen is measured with a variable orifice. The air permeability of the test specimen is determined from the pressure drop across this orifice, and is digitally displayed in the selected unit of measure for direct reading. High, stability, precision pressure sensors provide for an excellent measuring accuracy and reproducibility of the test results.

This company also develops the FX3350 Dynamic Air Permeability Tester AIRBAG-TESTER Fig.2.4. This is a new and unique instrument for fast and accurate determination of the average dynamic air permeability of airbag fabrics and of the exponent of the air permeability curve in a selectable test pressure range.

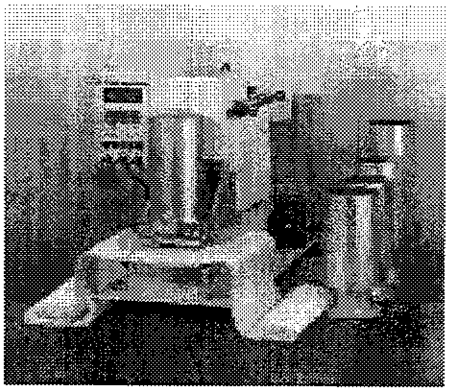


FIG 2.4 FX3350 AIR PERMEABILITY TESTER

The instrument simulates the conditions in an airbag during the inflation and deflation phase by exposing the specimen to a sudden blow of air, similar to the one occurring in an airbag. To produce this blow of air, a storage volume is loaded to a selectable start pressure, and the compressed air is then released to the outside via an intermediate volume and through the test specimen. This causes the test procedure across the test specimen to rise within 10 t 30 ms to a maximum pressure differential of approx. 100 kPa (14 psi), and to drop back to zero within 100 to 300 ms.

The instrument measures the pressure in both volumes as a function of time. From this data it automatically computes the average dynamic air permeability of the test specimen and the exponent of the air permeability curve during the deflation phase in a selectable test pressures range. The standard test pressure range is 30 to 70 IPa (4.3 t 0.9 psi), which is the range most critical for airbags. The instrument digitally displays both test results.

The instrument can be equipped with different test heads. The change over simple and takes only a few seconds. Each test head covers a certain air permeability range, and with all test heads available, the entire air permeability range of airbag fabrics can be covered, from extremely dense fabrics to open new fabrics.

High stability, precision pressure and bulging sensors provide for an excellent measuring accuracy and reproducibility of the test results. (Hort vogt 2003)

Atwal investigates the air resistance of 140 needle-punched fabrics made from sixteen different fibres and fits an empirical relationship to the measured air-resistance data by using stepwise multiple-regression analysis. This analysis relates the air-resistance to the fabric parameters of mass per unit area, thickness, porosity, and fibre fineness and the author shows that the empirical relationship can predict the air-resistance accurately.

Genis, Andrianora and vol'f give details of a method for the air-permeability testing of melt-blown nylon 6, polyester-fibre, polyethylene-fibre, and polypropylene-fibre fabrics used for different purposes such as thermal insulation, geotextiles, or filter fabrics.

Various authors investigate the factors that influence air permeability. Lewandowski and Mlynarek present and analytical method for determining the permeability of nonwoken filter fabrics and give a derived formula that shows that the intrinsic permeability, fully characterizing the porous medium, depends on the fabric porosity, the fibre diameter, and shape factor determined experimentally.

Ganatra and Munshi investigate the effect of construction parameters of woken cotton fabrics on the air-permeability and bursting strength of the fabrics and study the relationship between air-permeability and bursting strength, with some indication of applicable test methods. (Textile progress 1993)

A method of measuring the Air permeability of fabrics has been in use of the Shirley Institute for some years. The Shirley Air Permeability apparatus shown in Fig 2.5.

The specimen is clamped and the suction pump is started keeping all the taps closed. When the required pressure drop, which is normally 1cm of water, is attained and the indicator of the draught gauge is steady the rate of flow is read of one the four Rotameters.

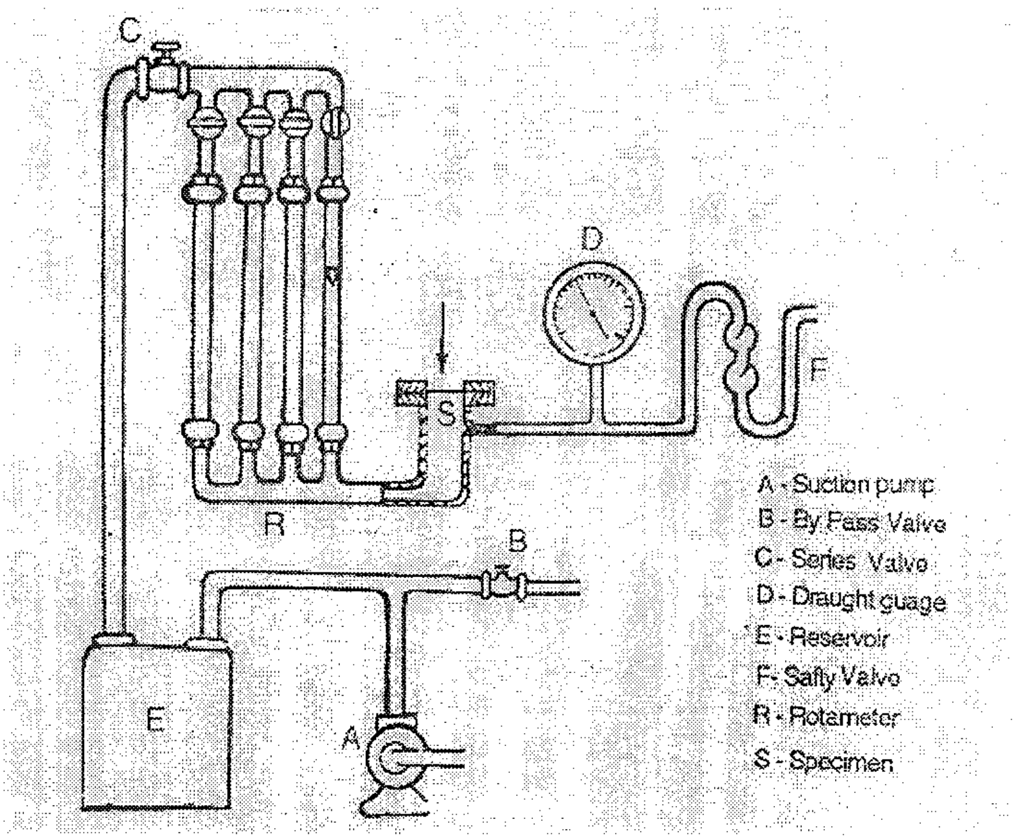


Fig.2.5 Shirley Air Permeability Tester

Out of the four Rotameters, anyone can be selected according to the type of fabric. The test is commenced with R_4 open and others closed. If the flow is less than 30 cu.cm/sec. R_3 is opened and R_4 is closed. In this way the suitable range is selected. To prevent any damage to the draught gauge, due to any undue pressure drop across the fabric, a safety valve is provided. (J.E Booth 1996)

The area of the sample exposed for the test is 5.07 sq.cm (i.e 1 inch diameter circular fabric is exposed to air). From the readings of the Rotameter, air permeability and air resistance can be calculated using the following formula.

$$\textbf{Air Permeability} = \frac{\text{Average rate of airflow}}{5.07} \ \textbf{cc/sec/sq.cm} \qquad (2.1)$$

$$\textbf{Air Resistance} = \frac{5.07}{\text{Average rate of airflow}} \ \textbf{sec} \qquad (2.2)$$

The Rotameters cover the following ranges:

R_1 : 0.05-0.5
R_2 : 0.5-3.5
R_3 : 3.0-35.0
R_4 : 30.0-350.0

In this instrument only test the heavy weight material because Rotameter value up to 350 so cannot measure the light and medium weight fabrics.

Thwing-Albert Instrument Company also develops the Akustron Air Permeability tester Fig.2.6. AKUSTRON measures the air permeability of filter papers, nonwovens and textile fabrics.

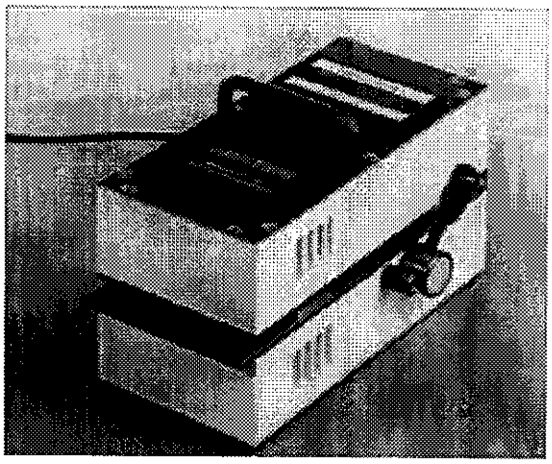


Fig.2.6 Akustron Air Permeability Tester

The sample is inserted into the slot, and the lever is pulled forward. This clamps the sample and begins the testing automatically. The method of measurement is based on two, long-life approved speakers. The speaker in the lower enclosure generates an oscillating air column, which displaces air through the test sample. A second speaker in the upper enclosure works as sensor and measures the amount of air that passes through the clamped sample. Results are shown immediately on the integrated digital display. (Thwing)

There are few instruments which measure air-resistance in place of air permeability. One such instrument in KES-F8-AP1 Air Permeability Tester, function of the tester is shown in Fig.2.7. In this instrument a constant rate of airflow is generated by the piston motion of plunger/cylinder mechanism and passed through a specimen to the atmosphere. The suction discharge periods of air are 5 seconds each and the air pressure loss Caused by the air resistance of the specimen is measured by a semiconductor differential pressures gauge. The air resistance of the specimen 'R' is directly indicated on a digital panel meter.

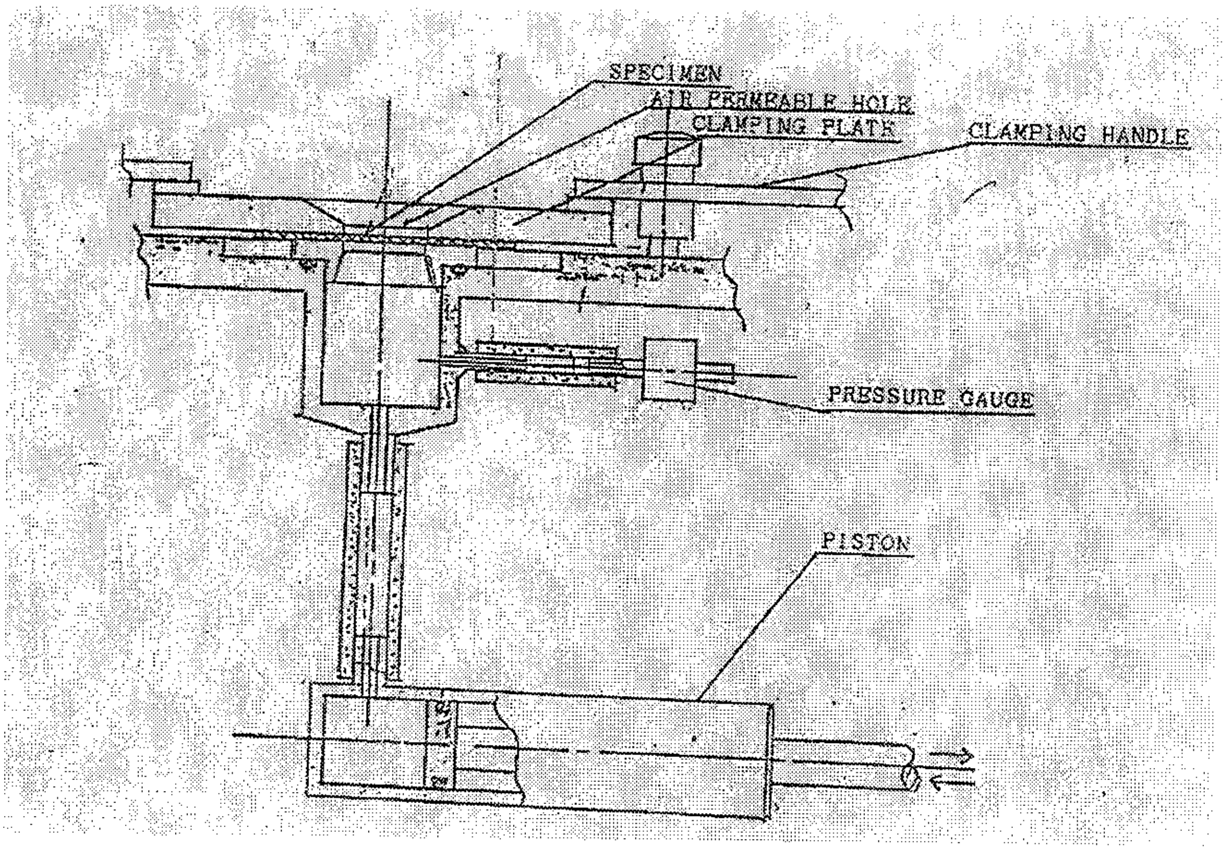


FIG.2.7 Function of the KES-F8-AP1 Air Permeability Tester

Air resistance "R" is obtained by pressure/rate of Air Flow as electrical resistance calculation while this tester has constant rate of air flow and pressure has linear relation with air resistance, air resistance is calculated from pressure difference.

$$R = \square P / V \qquad (2.8)$$

Where

□P = Pressure difference (Pa)

V = Rate of air flow $m^3/m^2.S$ per Unit area

CHAPTER 3

RESEARCH OBJECTIVE

- To Fabricate the Direct Air Passage Air Permeability Tester (DAP)
- To Determine the correlation of Air Permeability value determined using KES-F8-AP1 Air Permeability Tester
- To study the effect of PPI on Air Permeability of Fabrics using DAP Air Permeability Tester.
- To study the effect of weave on Air Permeability of Fabrics using DAP Air Permeability Tester.

CHAPTER 4

Methodology

4.1 Principle of Operation

Air from Compressor

↓

FRLCM unit

↓

Fabric Sample

↓

IR LED, Phototransistor & Fan Unit

↓

Frequency to voltage Converter

↓

Digital Output

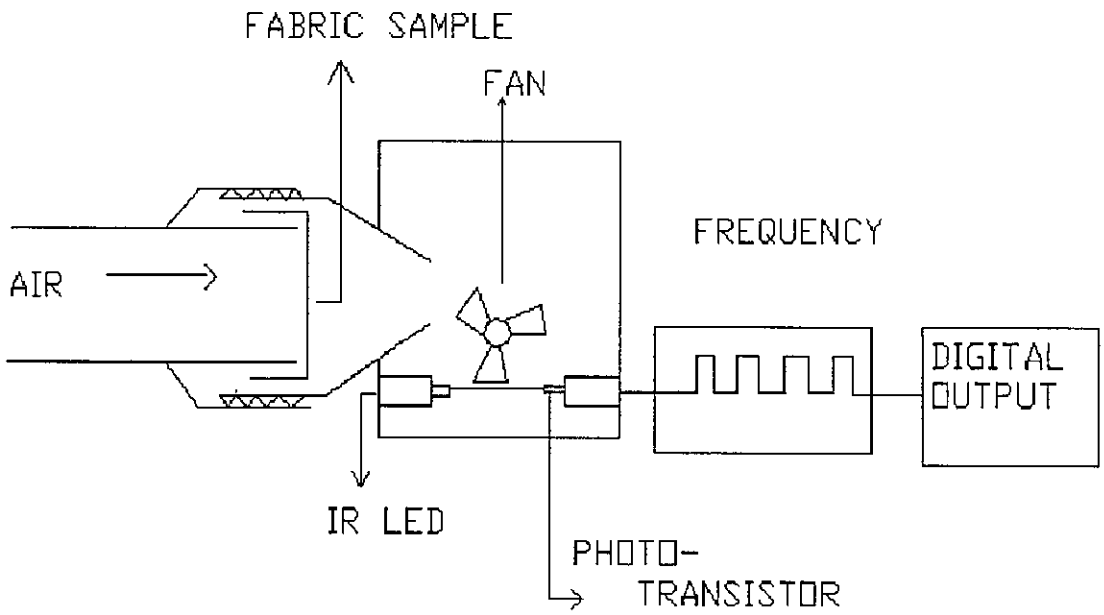


FIG.4.1 Working Principle Of the Dap Air Permeability Tester

Working principal of the DAP Air Permeability is shown in Fig 4.1 Compressor generates the compressed air and it reaches the FRCLM unit through the tube. This FRCLM unit filters the dust, moisture, contaminants and dirt in the compressed air. It also adds some lubricant for the smooth working of elements in the system. This unit also used to maintain the required secondary pressure for the system.

The output air goes to the solenoid value, which controls the direction of flow of air. Now the constant of air 0.5 Bar is fed to the fabric sample. The amount of air coming from the fabric sample is sensed by using an IR LED, PHOTO TRANSISTOR and FAN. IR LED acts as a transmitter and phototransistor as receiver. IR LED and Phototransistor are activated by a 5V-dc supply. The air that comes out of the fabric will activate the fan. At one tail end of the fan IR LED is connected with a 150-ohm resistor t the dc supply. The other tail and of the fan phototransistor is connected with a 1-k ohm resistor to the dc supply.

The dc supply is ON the phototransistor senses the IR Rays emitted from the IR LED. When the air that comes out of the fabric activates the fan the IR RAYS from the IR LED is blocked by the fan leafs. This gives a pulse train at the collector of phototransistor according to the fabric used.

The output value, which is displayed in the digital voltmeter, is calibrated to the air permeability of the fabrics.

4.2 TEST PROCEDURE

Selection of Cloth Sample

Light and medium weight fabrics (range from 60 to 170 g/m2) fabrics of different count and construction are taken and tested for Air Permeability

Sample Mounting Procedure

The sample was cut for the size of 90 mm X 90 mm. Using rubber tubbing the sample fixed in the sample holder.

Preliminary Operations

The prepared sample is placed on the sample holder and then the assemblage is mounted tightly over the sample. Initially the digital meter is set of '0' reading and the air, which is maintained at 0.5 Bar by FRCLM unit is allowed to pass through the fabric.

Data Obtained

When the flow had become steady, as indicated by the FRCLM unit, and the value in the digital meter is taken ten measurements for air permeability are made for each sample.

4.3 Standardization of Distance between Air nozzle and Fan

The tests were carried out for standardize the distance between air nozzle and fan was determined to an accuracy of 95% confidence level. First I have selected two distances 2 and 2.5 cm, each of this 20 individual reading were taken for sample. Standard deviation and mean were calculated for those reading. The distance accuracy was calculated using the formula given below at two distances.

$$P = \frac{1.96 * V}{N} \quad (4.1)$$

Where, N = Number of Test

P = % of Error

$$V = \frac{100 * \text{Standard Deviation}}{\text{Mean}} \quad (4.2)$$

The percentages of Error Distance at 2 cm = 0.28

2.5 cm = 0.26

4.4 Mechanical and Electronic Components

4.4.1 Pneumatic Equipments

4.4.1.1 Description of Pneumatics

In Greek language, "PNEUMA" means breath or air. The study related to the utilization of compressed air is called as Pneumatics.

Systems, machines & devices that use compressed air as the input energy for their operation are termed as Pneumatic Equipments. A basic pneumatic system consists of the following elements.

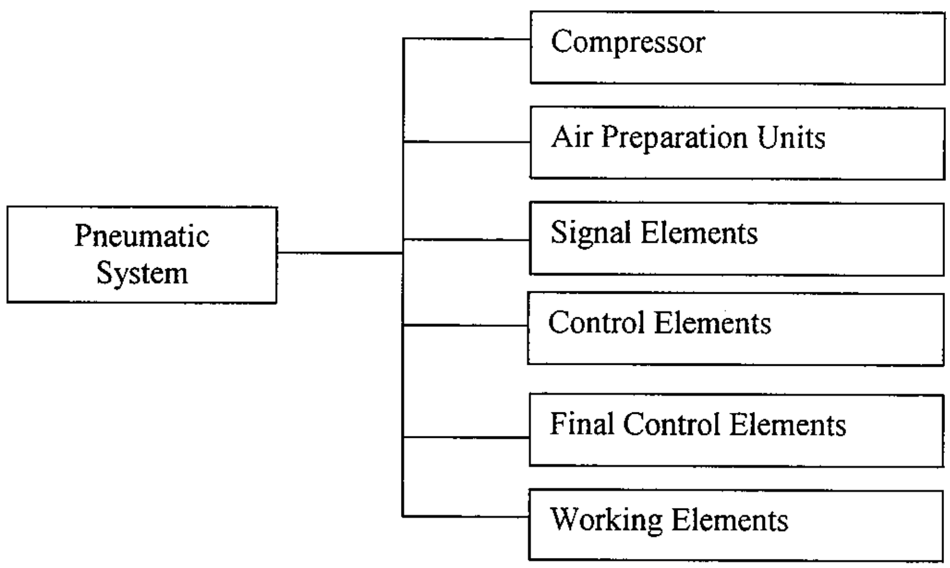


FIG 4.2 Basic Pneumatic System

4.4.1.2 Air Cylinders

Air cylinders convert Pneumatic energy into Mechanical energy in a linear motion. There are two types of air cylinder available. They are single acting cylinder and double acting cylinders

Single acting cylinders are, performing operating force/motion only in one direction. For motion in the other direction, they depend on a spring or some other external mechanical force. Normally these cylinders have piston rod extension on one side only and piston or diaphragm operated.

Double acting cylinders are, performing operating force/motion in both directions of the piston movement. Normally these cylinders may also have piston rod extension on either side of the piston.

4.4.1.3 SOLENOID VALVE

These valves come under the category of control elements. These are electrically operated valves. When the coil receives an electric signal, the magnetic field created within the valve pulls the moving core upwards regardless of the spring force pushing downwards, thus enabling a connection from IN to OUT.

4.4.1.4 AIR PREPARATION UNITS – FRCLM UNIT

It is common knowledge that atmospheric air contains certain amount of water vapour in it. When the air is compressed and used, it carries with it the water vapour also. This compressed air when used in pneumatic system without removing the moisture entrapped in it can corrode the cylinders and valves and reduces their life. The moisture can combine with lubricating oil and form an emulsion, which can cause sticking of moving components of electro valves resulting in malfunctioning of the system. The problem will be more during the rainy season or in areas where relative humidity is high. In coastal areas, the water will be salty and the problem of corrosion will be much more.

It is clear from the above, the moisture can corrode the pneumatic system components and cause costly replacement apart from loss due to machine down time. To overcome the problem, many methods are adopted to separate the moisture from the compressed air effectively, before it reaches the use point. The most commonly used system is Filter, Regulator and Lubricator units.

FRCLM unit is nothing but "Filter Regulator Combination Lubricator Modular unit" the working of each element is given in the following sections.

Air Filter

Function of the Air filter is used to separate and remove dust, dirt, moisture and other contaminants present in the compressed air. When an unfiltered compressed air enters into the bowl chamber through "IN", it is set to a rotary motion by a separator. Due to the centrifugal force created, all the heavier particles are thrown to the sides of the wall, which then gets collected at the bottom of the bowl.

The air still contains impurities of smaller sizes. To remove these impurities the air is passed through a filter element. The pore size of the filtering elements (5, 10,25,40,50 microns) indicates the minimum particle size, which can be filtered. The clean, filtered air is delivered at the "OUT" port. The collected condensate is drained from the bowl through the drain valve, to prevent being carried away with the air current. An automatic drain valve can be used to discharge the collected condensate automatically.

Regulator

The function of air regulator is to maintain a constant secondary pressure (outlet) irrespective of the fluctuations in the primary pressure (inlet).

The inlet pressure should always be greater than the required set pressure. The regulator shown below is diaphragm operated, relieving type regulator. One side of the diaphragm is loaded by spring and the other side by the secondary pressure. The required pressure is set by a main spring. When the secondary pressure increases, more than the set pressure, the diaphragm pushes up the main spring, thus closing the valve seat. The secondary pressure starts to drop as it gets consumed. When the secondary pressure drops below the set pressure the spring pressure acts on the diaphragm, which in turn opens the valve seat allowing airflow at the required set pressure, thus maintaining a constant secondary pressure. The reading of the working pressure can be taken from a pressure gauge.

Lubricator

Functions of the Lubricators are used to feed lubricants to the compressed air, where necessary. The dry air stream entering through the inlet port is deflected using a flexible deflector, creating a low-pressure area. A portion of the pressurized air enters into the bowl chamber. The pressure exerted on the oil carries it to the oil drop chamber through the tube. When the oil reaches the chamber the low pressure created by the deflector sucks the oil from the chamber into the air stream.The require amount of oil can be mixed with the air using the adjustable needle controller.

4.4.2 Circuit Designing

The circuit design Fig.4.3 used for fabrication of DAP Air Permeability tester

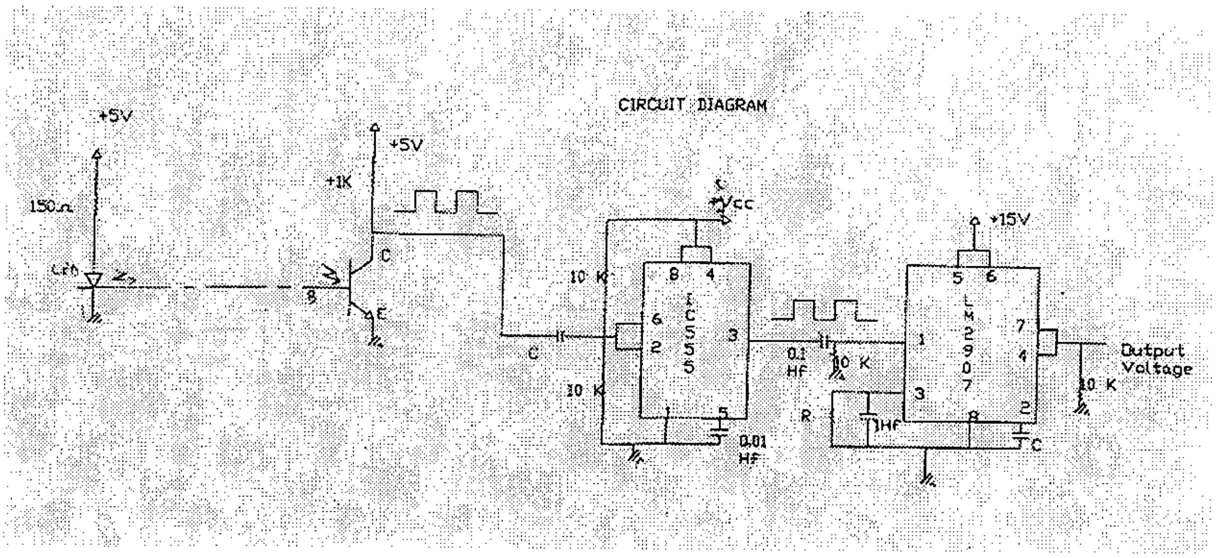


FIG.4.3 CIRCUIT DIAGRAM OF THE DAP AIR PERMEABILITY TESTER

Stage1:

A transformer to convert single-phase 230V supply to 15V Output.

Stage2:

From this 15V supply all the electronic components namely resistor, emitters, receivers, IC and transistors are connected in sequence according to the circuit design.

Stage3:

The output from the sensor is indicated in the digital voltmeter.

4.4.3 List of Electronic Components Used

The following Electronic Components are used in the DAP Air Permeability Tester.

- Power Supply Section

  - 12-0-12 Transformer
  - IN 4007 Diode
  - 1000 μF/25V, 0.1 μF Capacitor
  - IC 7805, 7815
  - Zener Diode-5V, 15V

- Sensor Section

- IR LED
- Photo Transistor (npn series)
- 5V power supply
- 1 KΩ, 150Ω Resistors

- Pulse Shaping Section

- 1 μF/16V capacitor, 0.01μF Capacitor
- IC 555
- 10 K ohms
- 5V power supply

- Frequency to Voltage Converter Section

- 0.1μF, 1μF, Capacitors
- 10 KΩ, 100 KΩ Resistors
- IC LM2907
- 15 V Power Supply

- Digital voltmeter

4.4.4 FUNCTIONS OF ELECTRONIC COMPONENTS

Electronic component are classified into either being Passive devices and Active devices.

A passive device is one that contributes are components no power gain (amplification) to a circuit or system. It has no control action and does not require any input other than a signal to perform its function. In other word's," A component with no brains!" Some examples are Resistors, Capacitors & Inductors.

Active devices are components that are capable of controlling voltage or current and create a switching circuit. In other words, "Devices with smarts!" some examples are Diodes, Transistors & Integrated circuits.

Electronic components-passive

Resistors

Physical materials resist the flow of electrical current to some extent. Certain materials such as Copper offer very low resistance to current flow, and hence they are called as conductors. Other materials such as Ceramic, which offer extremely high resistance to current flow, are called as insulators. In electric & electronic circuits, there is a need for materials with specific values of resistance in range between that of a conductor and an insulator. These materials are called resistors and their value of resistance is expressed in Ohms.

Fixed Resistors

This is most widely used resistor in discrete circuits. The Carbon resistors are made of finely divided Carbon mixed with a powdered insulating material such as resin or clay in the proportions needed for the desired resistance value. These are then placed in a casing Lead wires of Tinned Copper. Resistors of this type are available in the range from few Ohms to 100 mega ohms and typical power rating of 1/8 to 2W.

Capacitor

Capacitors are vary in size & shape-from a small surface mount model to a huge electric motor cap the size of a paint can. Whatever the size or shape, the purpose is the same. It stores electrical energy in the form of electrostatic charge. We will get into the mechanics & further properties of this later. The size of the capacitor generally determines how much charge it can store. A small surface mount or Ceramic capacitor will only hold a minuscule charge. Some of the large electrolytic capacitor will store a much larger charge. Some of the large electrolytic capacitor can store enough charge to kill a person. Another type, called Tantalum capacitors, store a larger charge in a smaller package.

Resistor colour codes & Primer

Resistors are colour coded for easy reading. To determine the value of a given resistor look for the gold or silver tolerance band. Look at the first colour band and determine its colour. This may be difficult on small or oddly coloured resistors. Now look at the chart and match the first and second band colour to the "digit it represents". Write this number down.

Now look at the second colour band and match that colour to the same chart. Write this number next to the first digit. The last colour band is the number you will multiply the result by. Match the third colour band with the chart under multiplier.

This is the number you will multiple the other two numbers by. Write it next to the other two numbers with a multiplication sign before it.

Table 4.1 - Resistor Colour Code Chart

	Digit it represents	Multiplier
Black	0	X1
Brown	1	X10
Red	2	X100
Orange	3	X1000 or 1K
Yellow	4	X10000 or 10K
Green	5	X100000 or 100K
Blue	6	X1000000 or 1MK
Violet	7	Silver is divided by 100
Grey	8	Gold is divided by 10
White	9	Tolerance: Gold-5% Silver-10% None-20%

Electronic Components – Active

Diodes

Diodes are basically a one-way valve for current. They let it flow in one direction (from positive to negative) and not in the other direction. Most diodes are similar in appearance to a resistor and will have a painted line on one end showing the direction or flow (white side is –ive). If the negative side is on the negative end of the circuit, current will flow. If the negative is on the +ive side of the circuit no current will flow.

Transistors

The transistor is possibly the most important invention of this decade. It performs two basic functions.

1) It acts as a switch turning current ON & OFF
2) It acts as an amplifier.

This makes an output signal that is a magnified version of the input signal. A transistor comes in several sizes depending on their applications. It can be a big power transistor such as is used in power amplifies in your stereo, down to a surface mount (SMT) and even done to 0.5 microns wide such as in an ICs.

Integrated Circuits

ICs are complex circuits inside one simple package. Silicon & metals are used to simulate resistors, capacitors, transistors, etc. It is a space saving miracle. These components come in a wide variety of packages & sizes. You can tell them by their "monolithic shape" that has a ton of "pins" is coming out of them. Their applications are as varied as the packages. It can be a simple timer, to a complex logic circuit, or even micro controller with erasable memory built inside.

Transformer

A transformer is a static (or stationary) piece of a apparatus by means of which electric power in one circuit is transformed by means of same frequency in another circuit. It can rise or lower the voltage in a circuit, but with a correspondent decreases or increases in current. The physical basis of a transformer is mutual induction between two circuits linked by a common magnetic flux. In its simplest form, it consists of two inductive coils, which are electrically separate but magnetically linked through a path of a low reluctance. The two coils possesses high mutual inductance. If one coil is connected to a source of AC voltage and alternate flux is set up in the laminated core, most of which is linked with the other coil in which it produces mutually induced EMF. If the second coil circuit is closed, a current flows in it and so electric energy is transferred from the firs coil to the second coil. The first coil, in which electric energy is fed from the supply mains, is called primary winding and the other, from which energy is drawn out, is called secondary winding. In brief, a transformer is a device that

- ✓ Transfers electric power from one circuit to another
- ✓ It does so without charge of frequency.
- ✓ It accomplishes this by electromagnetic induction
- ✓ Where the two electric circuits are in mutual inductive influence with each other.

CHAPTER 5

RESULTS AND DISCUSSIONS

5.1 Correlation between DAP Air Permeability Tester and KES-F8-AP1 Air Permeability Tester

Using the software SPSS the spearman's correlation coefficient is determined between air permeability values of DAP Air Permeability Tester and KES-F8-AP1 Air Permeability Tester. Good correlation is found between the results on r = +0.961 which is significant at 99% confident interval.

5.2 Fabric specifications

The four different weave types selected are plain, matt, twill and satin. A Cotton yarn is employed in the warp and weft ways and the yarn counts 2/40 s. Two different pick spacing like 32, 39 and Ends per Inch 43 is used. The cloth cover varied 16.10 to 17.20. The cloth thickness varied from 0.41mm to 0.53mm.

5.3 Effect of Pick Density on Air Permeability

The woven materials are selected with different weave like plain, matt, twill, and satin produced from yarn count of $2/40^s$ and with two different picks/inch as 32, 39 and ends/inch 43 is used. Air permeability values of woven fabric having different construction parameters are tabulated as given in Table 5.1.

From the table it is noted that as the picks/inch increase air permeability decreases. The plain woven and satin materials are having high values of air permeability compared to that of twill and matt.

Table – 5.1 Air permeability of woven fabrics

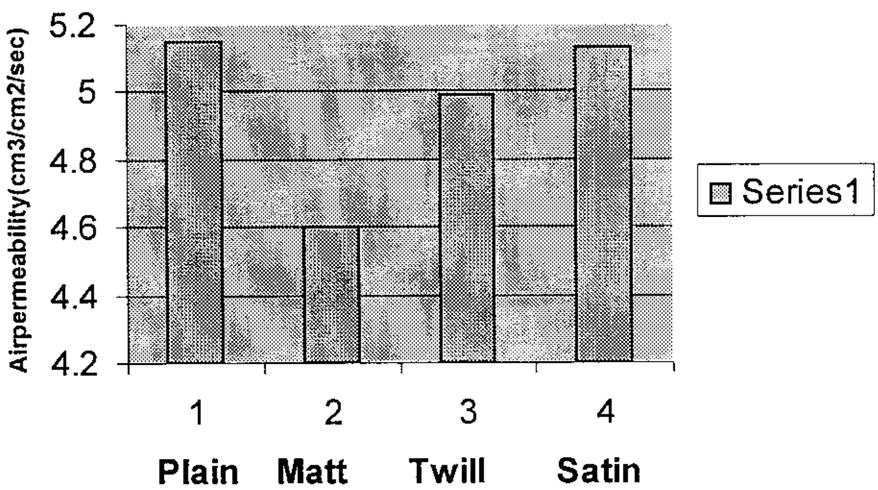
Design	Weave	PPI	EPI	Areal Density (gsm)	Thickness (mm)	Cloth Cover	Air permeability
Plain	1/1	125	169	124	0.41	16.10	5.15
Plain	1/1	154	169	130	0.41	17.20	4.94
Matt	2/2	125	169	116	0.42	18.40	4.99
Matt	2/2	154	169	124	0.46	17.20	4.61
Twill	2/2	125	169	121	0.52	16.10	4.99
Twill	2/2	154	169	135	0.53	17.20	4.79
Satin	4ends	125	169	128	0.52	16.10	5.15
Satin	4ends	125	169	133	0.53	17.20	4.64

5.4 Effect of Weave on Air Permeability

The effect of weave on air-permeability for four types of woven fabrics at different picks spacing is as shown in table 5.1. The relations between weave (Plain to satin) and air-permeability for pick spacing of 125 and 154 is very clear, i.e. the air-permeability shows a decreasing order from plain to satin. The observation reveals that the air-permeability decreases depending on the construction of weave.

The measurement of air-permeability is a vital characteristic in the manufacture and performance of textile fabric, i.e., in assessing wind resistance or air-tightness of fabrics. It is noted that the factors which influence the air permeability are the construction areal density, thickness of the fabric selected (figure 5.1 and table 5.1)

Fig 5.1- Effect of weave of Airpermeability



CHAPTER 6

CONCLUSION

The following conclusions are drawn on the investigation of this project.

- The new Direct Air Passage (DAP) Air Permeability Tester has been designed.

- Good correlation of +0.961 is found between the results of DAP air permeability tester and KES- F8-AP1 air permeability tester.

- Increase in PPI decreases the air permeability.

- The Air permeability of a fabric depends on its thickness, construction, etc

- Plain-woven fabric is more Air Permeability than other fabrics.

APPENDIX

Nonparametric Correlations

Correlations

			DAPT	KES
Kendall's tau_b	Correlation Coefficient	DAPT	1.000	.937**
		KES	.937**	1.000
	Sig. (2-tailed)	DAPT	.	.000
		KES	.000	.
	N	DAPT	100	100
		KES	100	100
Spearman's rho	Correlation Coefficient	DAPT	1.000	.961**
		KES	.961**	1.000
	Sig. (2-tailed)	DAPT	.	.000
		KES	.000	.
	N	DAPT	100	100
		KES	100	100

**. Correlation is significant at the .01 level (2-tailed).

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