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Design and Fabrication of Low Cost Digital Peel Tester

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ABSTRACT:The Synopsis mainly focuses on measuring peel strength of adhesive tapes. Peel strength is average force required to separate two bonded materials from one another, is properly applicable to various industries aerospace, automotive, adhesives, packaging, biomaterials, microelectronics, and more. Peel test data is used to determine the quality of the adhesive joint and, where applicable, provides information on the effects of processes. Peel tests are constant-speed tests in the tensile direction. In material testing, peel strength is calculated after measuring and averaging the load to peel the specimen and dividing the average load by unit width of the Adhesives. Different adhesives are used for joining the different types of materials. The different types of peel tests available for investigating the adhesive strength are 90°, 135°, 180° and T-peel test. This mechanism mainly focuses on 180° peel type test

KEYWORDS:Peel strength, 180° peel test, Motor having low rpm, Leadscrew, Measuring gauge

I. INTRODUCTION

A Proposed Mechanism for Peel Strength Measuring Machine is mainly focused on measuring the Peel strength of adhesive tapes. Peel strength is very important factor for any type of adhesive. Because it plays very important role for the selection of adhesive and as per the requirement parameter. Peel strength is generally used to measure the bond strength of a material, typically an adhesive. Peel strength is the average load per unit width of bond line required to separate bonded materials where the angle of separation is 180 degrees. Peeling tests are the practice of testing adhesion properties of film bonded to substrate, usually by tensile. The peel strength determines the adhesive strength (also called the adhesive fracture toughness). Physical testing of packaging products by peeling can tell us a lot about its properties and manufacturing process such as sealing consistency, bonding strength, adherence ability, cohesive properties of the interface, bond durability and other parameters.

Measurements require a force gauge, suitable grips (capable of clamping the tape firmly and without slippage throughout the tests) and a motor driven mechanism to pull the product under test at a steady rate and controlled angle. Clamp the bent and unbonded ends of the test. Apply the force measure and record the force response. Ideally the force versus displacement reading to initiate and propagate the response should be recorded.

II. LITERATURE REVIEW

1] Peel tests have a major advantage over tensile tests in that a much thinner electrodeposited coating is required. From a practical point of view, the coating must be strong enough to permit continuous peeling of the deposit from the substrate. However, problems are likely to be encountered if the coating is brittle, when it will not permit continuous

peel. Jacquet³⁵ introduced a method in which a grip is electroformed onto the plated component, but direct peel tests in which the coating itself is lifted and gripped, are much simpler when feasible.[1]

2] Peel tests intended for flexible adhesives are designed to measure resistance to highly localized stresses. Peel forces are therefore considered as being applied to linear fronts. The more flexible the adherend and the higher the adhesive modulus, the more nearly the stressed area is reduced to linearity. The stress then approaches infinity. Since the area over which the stress is applied is dependent on the thickness and modulus of the adherend and the adhesive, and is therefore very difficult to evaluate exactly, the applied stress and failing stress are reported as linear values, i.e., pounds per linear inch. Probably, the most widely used peel test for thin-gauge metal adherends is the T-peel test (ASTM D1876).[2]

3] The peel test is a seductively simple experimental method by which one attempts to measure the interface toughness of a film/substrate system. When the adherends (film and substrate) are elastic materials and the film undergoes steady-state peeling, it is universally agreed that the experimentally measured peel force per unit film width is directly related to the work of fracture of the interface, as detailed below. Assuming the strain energy per unit area in the straight portion of the detached film is much smaller than the peel force per unit width (which is almost always the case), the work done by external force is equal to the work of the interface separation. However, when one or both of the joined materials undergo plastic deformation during steady-state peeling, the peel force per unit width equals the sum of the interface fracture energy and the plastic dissipation. For many systems, the plastic dissipation can be much larger than the interface fracture energy. [4]

III. PROBLEM STATEMENT

- 1.Currently industries are using the peel strength measuring machine which works on the mechanism of '90° peel test type A' in which the complexity of the machine is very high which resulted in high cost of the machine.
- 2.But as peeling angle increases the accuracy will also increases, so we are focusing on '180° peel test type B' as per ASTM standard D3330.
- 3.During market survey it is found that peel tester are available in market are having cost of 50000 rs to 100000 Rs.
- 4.Hence to reduce machine complexity and cost , it is necessary to design and developed low cost digitalized peel tester .

IV. CONSTRUCTION AND WORKING

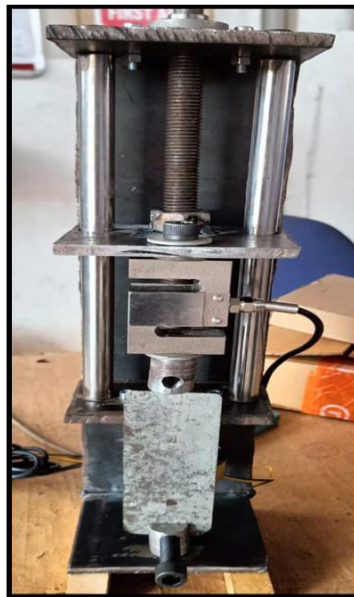


Fig 4.1 Machine Construction

- 1.Insert the tail of the sample into the roller jaw and pull gently to lock. Wrap a piece of paper around the tail to keep the grip free from gross contamination by the adhesive.
- 2.Pull the sample back on itself [180°] attempting to maintain a speed sufficient to move the adhesion test front 25 mm (1") in 10 seconds using the marks as a guide to peel speed. This will give a movement of the roller grip of 300

mm/min (12"/min) -- more if the carrier film stretches. It may be impracticable to strictly control the test speed under changing environmental conditions.

3. Record the average and maximum loads shown on the spring balance in kilograms.

4. Calculate the peel strength by multiplying the average load by 9.81 to convert to Newtons and divide by 25mm/1" [or the peel strip width in mm if appropriate] to give the peel strength in Newton per millimetre width [N/mm].

V. CONCEPTUAL DESIGN

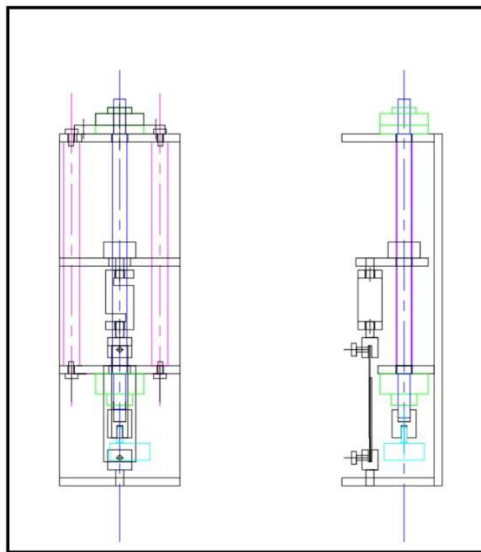


Fig 5.1 Conceptual Design 1

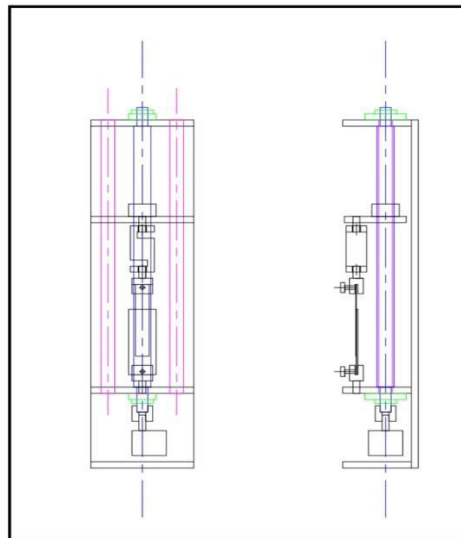


Fig. 5.2 Conceptual Design 2

VI. ADVANTAGES

1. High strength efficiency
2. High torque
3. Good measuring quality
4. It can be measure many packaging tape strength
5. Operation is noise less

6. Well balance system Complex shapes easily operate.
7. More accurate.

VII. COMPONENTS OF PEEL TESTER

7.1 AC Synchronous motor



Figure No-7.1 AC Synchronous Motor
Rpm = 5-6rpm , Voltage = 220v , Synchronous Power = 4w

A synchronous electric motor is an AC motor in which, at steady state, the rotation of the shaft is synchronized with the frequency of the supply current; the rotation period is exactly equal to an integral number of AC cycles. Synchronous motors contain multiphase AC electromagnets on the stator of the motor that create a magnetic field which rotates in time with the oscillations of the line current. The rotor with permanent magnets or electromagnets turns in step with the stator field at the same rate and as a result, provides the second synchronized rotating magnet field of any AC motor. A synchronous motor is termed doubly fed if it is supplied with independently excited multiphase AC electromagnets on both the rotor and stator. Adhesive peel tester machine motor generate force for rotating the middle screw and varied the middle plate. In this peel tester which uses only one synchronous motor this rotate the clockwise and anticlockwise. The motor device which used to convert rotating motion to reciprocating motion. The synchronous motor and induction motor are the most widely used types of AC motor.

7.2 Lead Screw



Figure No-7.2 Lead Screw

Rod Length = 360mm Diameter = 18mm

The rod used for the plate varies from downward to upward and upward to downward. Rod rotate by motor with 5 rpm and varies the middle plate, Rod fit into the lower bearing and upper bearing. With respect to shape, stud bolts a.k.a. studs are categorized into three basic types: "fully threaded stud bolts", "tap end stud bolts", and "double end stud bolts". Each of these studs have different application. As name suggests, fully threaded studs have full body coverage with threads for full engagement of the matings nuts or similar parts. Tap end studs have threads at extreme ends of the

body with unequal thread engagement length. while double end stud bolts have equal thread length at both ends. Apart from these there are stud bolts for flanges which are fully threaded studs with chamfered ends, and double end studs with reduced shank for special bolting applications. For studs that are not completely threaded, there are two types of studs: full-bodied studs, and undercut studs. Full-bodied studs have a shank equal to the major diameter of the thread.

7.3 Load Cell



Fig.7.3 Load cell

S-type load cells are mainly used to measure tensile forces, but also are suitable for compressive force measurement. As the name implies, these load cells are shaped like the letter S. The spring element is located in the centre beam of the load cell.

S-type load cells are mainly used to measure tensile forces, but also are suitable for compressive force measurement. As the name implies, these load cells are shaped like the letter S. The spring element is located in the centre beam of the load cell. This element is a piece of metal that is elastically deformed under load and recovers the moment the load is removed. This deformation or strain is picked up by strain gauges installed on the spring element and converted into an electrical signal. In S-type load cells, the spring element is deformed at both ends by compression or tension. In contrast to other load cells, S-type load cells can be calibrated in weight units and also in Newton, as they are widely used as force transducers.

VIII. OBJECTIVES

- 1.Design of peel test mechanism.
- 2.Load cell implementation.
- 3.Digitalization of reading.
- 4.Guide design.

IX. APPLICATIONS

- 1) Material Packaging centre
- 2) Food industry
- 3) Medical equipment packaging

X. FUTURE SCOPE

In this machine, we develop more and more modified technique with increasing the aesthetic look and economic consideration. But being the degree Engineers and having the ability to think and plan. Tensile test machines, also known as tension test machines, are universal testing machines specially configured to evaluate the tensile strength of specimens. Our tensile testers will measure characteristics such as ultimate tensile strength, yield strength, elongation, and modulus. Each tensile test machine is configured to your testing needs by our application engineers with the correct controller, grips, and accessories

XI. RESULTS AND CONCLUSION

Peel Strength Tester is widely used testing machine which is used in different packaging products manufacturing e strength of self-adhesive products such as tapes, labels and many more. The adhesive products are tested to measure the maximum amount of force that an adhesive material requires to leave another substrate on which it is applied. Peel Strength Test is one of the best testing machines which are used to measure the bonding strength of the packaging materials. The test is performed to ascertain the bond strength of the adhesives even in tough working conditions. These tests are tools for quality assurance control and use, the benefit of performing objective, accurate and repeatable peeling testing can improve product consistency and assess interface adhesion. It is expected to cost of other systems currently



on the market is high. Bottom line is it help not only to just reduce the price of that machine but it can give e mechanism to perform peel strength test. The adhesive products are tested to measure the maximum amount of force that an adhesive material requires to leave e of the best testing machines which are used to measure the bonding strength of the packaging materials.

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