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Tensile Strength Measurement for Foundry Sand Brick

Manasi V. Magdum[1], Dr. B.T. Salokhe[2] and Prof. A.S. Mali[3]
[1]M. E. Student, Department of Electronics Engineering, Tatyasaheb Kore Institute of Engineering & Technology, Warananagar, INDIA
[2]Head of Department, Department of Electronics Engineering, Tatyasaheb Kore Institute of Engineering & Technology, Warananagar, INDIA
[3]Assistant Professor, Department of Electronics Engineering, Tatyasaheb Kore Institute of Engineering & Technology, Warananagar, INDIA

[1]Corresponding Author: manasi3010@gmail.com

ABSTRACT

Tensile strength is an important concept in engineering, especially in the fields of material science, mechanical engineering and structural Engineering. The tensile strength of a material is the maximum amount of tensile stress that can be applied to it before it ceases to be elastic. If more force is applied the material will become plastic or even break. Passed the elastic limit, the material will not relax to its initial shape after the force is removed. See Hooke's Law and Modulus of elasticity. The tensile strength where the material becomes plastic is called yield tensile strength. This is the point where the deformation (strain) of the material is unrecovered, and the work produced by external forces is not stored as elastic energy but will lead to contraction, cracks and ultimately failure of the construction. Clearly, this is a remarkable point for the engineering properties of the material since here the construction may lose its loading capacity or undergo large deformations. On the stress-strain curve below this point is in between the elastic and the plastic region. The Ultimate Tensile Strength (UTS) of a material is the limit stress at which the material actually breaks, with sudden release of the stored elastic energy. Tensile strength is measured in units of force per unit area. In the SI system, the unit is Newton per square meter (N/m² or Pa - Pascal). The U.S customary unit is pounds per square inch (or PSI).

Keywords--- Hooke's law, Tensile strength, Bayesian network

I. INTRODUCTION

The maximum load applied in breaking a tensile test piece divided by the original cross-sectional area of the test piece. Originally quoted as Kg/sq.cm. It is now measured as Newton/sq.inch. Also termed Maximum Stress and Ultimate tensile stress. On the stress-strain curve below this point is in between the elastic and the plastic region. The Ultimate Tensile Strength (UTS) of a material is the limit stress at which the material actually breaks, with sudden release of the stored elastic energy. [1]. Tensile testing is performed on a variety of materials including metals, plastics, elastomers, paper, composites, rubbers, fabrics, adhesives, films, etc. Tensile testing is commonly used to determine the maximum load (tensile strength) that a material or a product can withstand. Tensile testing may be based on a load value or elongation value.

II. EXISTING METHODOLOGY

Mechanical properties are the attributes of a metal to withstand several forces and tensions. Specifically, ultimate tensile strength is the force a material can resist until it breaks. The only way to examine this mechanical property is the employment of destructive inspections that renders the casting invalid with the subsequent cost increment. In a previous work we showed that modelling the foundry process as a probabilistic constellation of interrelated variables allows Bayesian networks to infer causal relationships. In other words, they may guess the value of a variable (for instance, the value of ultimate tensile strength). Against this background, we present here the first ultimate tensile strength prediction system that, upon the basis of a Bayesian network, is able to foresee the values of this property in order to correct it before the casting is made. Further, we have tested the accuracy and error rate of the system with data of a real foundry.

III. PROPOSED METHODOLOGY

Proposed methodology will perform ultimate tensile strength is the maximum stress any material can withstand when subjected to tension; in other words, the strength a material is able to resist until it breaks. Hence, assuring that all pieces manufactured reach a certain ultimate tensile strength threshold is an essential goal of the quality tests. If we apply the inference ability of Bayesian Networks [3] in order to achieve an effective prediction. Bayesian networks are probabilistic models very helpful when facing problems that require predicting the outcome of a system consisting of a high number of interrelated variables. The Bayesian network learns the behavior of the model and, thereafter it is able to foresee its outcome. In this way, successful applications of Bayesian networks include for instance email classification for spam detection [4], failure detection in industrial production lines [5] [6], weather forecasting [7] [8], intrusion detection over IP networks [9] [10] or reconstruction of traffic accidents. In all cases, the respective target problem is modelled as a constellation of interconnected variables whose output is always the result of the prediction (e.g. spam found, failure detected, intrusion noticed and so on). Similarly, the production process of a foundry is perfectly suitable to be modelled as system of variables whose behavior may influence in one way or another the mechanical properties of the obtained piece. Against this background, this paper advances the state of the art in two main ways. First, we present here, for the first time, a Bayesian-network-based mechanical properties prediction system that is especially designed to calculate before producing it the ultimate tensile strength of the manufactured piece. Second, we introduce here a methodology to test the accuracy and error rate of a Bayesian network for the prediction of the ultimate tensile strength in foundry processes.

IV. BLOCK DIAGRAM

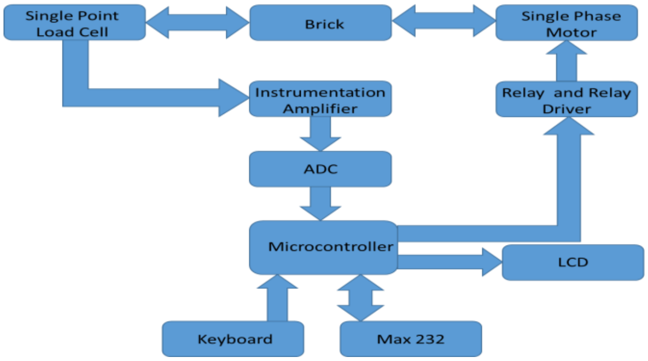

Fig.1: Proposed system Block diagram

V. SYSTEM OPERATION

In the block diagram single point load cell of the brick is connected at one end. The relay and driver circuit is used to drive the single phase motor (45 rpm). The microcontroller 89C51 is used to give signal to driver circuit. When we turn ON the switch start the motor and controller takes first reading after some time delay it takes second reading and start comparing if first reading is greater than second reading then store this reading as a break point reading and then reverse and stop the motor.

VI. HARDWARE IMPLEMENTATION

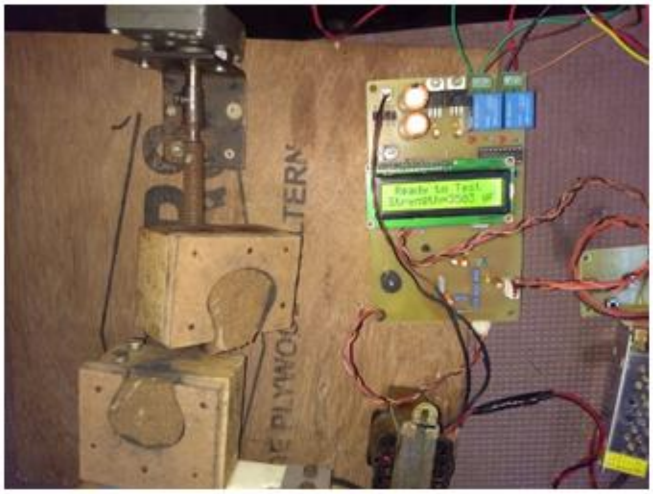

Fig.2: Circuitry for tensile strength measurement for foundry sand brick

To design and develop this system which predict accurate tensile strength of sand include the following parameters that need to be calculated.

1. Determine Load at various instant of time and use parameter to represent graph.
2. To calculate deflection of Maximum Load and break point.
3. Compute and work at Maximum Load.
4. Calculate Stiffness.
5. To determine chord slope.
6. To calculate stress and strain.
7. Display the desired graph.
8. To decide whether it is good or not for optimal quality of product and profitability of foundry.

VII. SOFTWARE IMPLEMENTATION

When we turn ON the switch start the motor and controller takes first reading after some time delay it takes second reading and start comparing if first reading is greater than second reading then store this reading as a break point reading and then reverse and stop the motor.

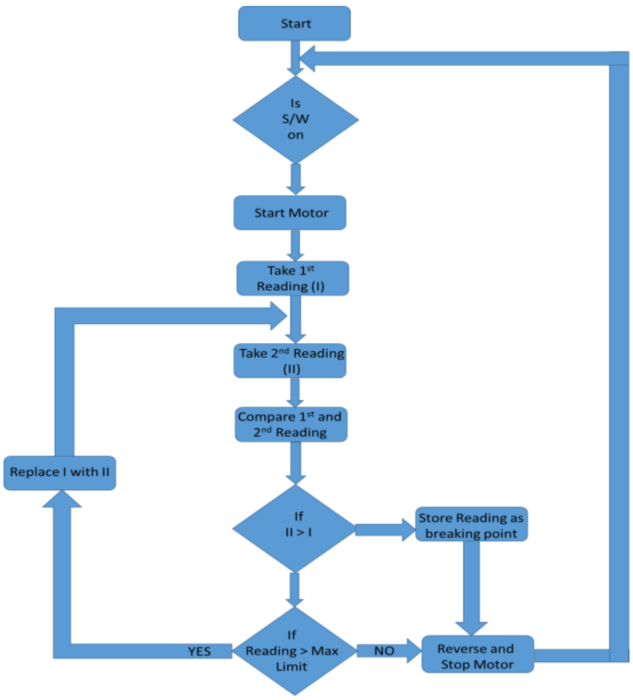

Fig3. Flow chart of Tensile Strength Testing for Foundry Sand Bricks

VIII. RESULT ANALYSIS

The force was applied with the help of DC motor. Motor offers tensile resistance to the brick and in turn to load cell as shown in the setup. The bridge in load cell gets unbalanced and differential output voltage proportional to applied force is produced across load cell output. This is converted to single ended output with the help of amplifier and given to ADC. It converts into digital form and LED displays that digital output is the tensile strength of sand. The tensile strength of foundry sand brick is 3.5 N/m^2.

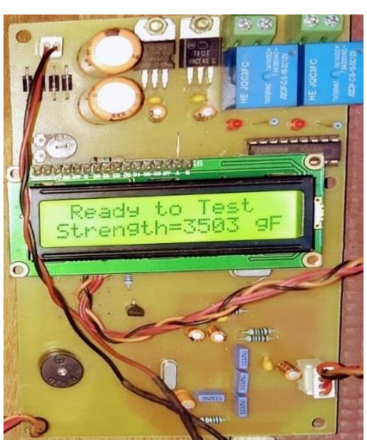

Fig.4: Hardware model for foundry sand brick

IX. CONCLUSION

This project work shows that the behavior of the system can be outperformed in the following way:

When the system detects that the probability of a bad value of the ultimate tensile strength to appear is very high, the operator may change the factor to produce another reference.

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