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Reduce Vibration Of Robot Finger Using Different Materials

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***Abstract*— A robot is a machine which can be guided by an external control device (or) the control may be embedded within. The branch of technology deals with design,construction,operation, and application of robots. As well as computer system of their control, sensor feedback, information processing, to how act of robot in as computer. Application fields of robot,welding, material handling, food industry to use in pick and place processing and domestic application etc… In this project, the study has been made to develop of finger material change for robots in the field of food industries. Already food industries have to use in so many materials of robot fingers. In sample of silicon rubber material to reference of this project. But we change in the materials of silicon rubber alternative to Viton flouro elastomer. Both materials for soft contact and withstand high temperature. So, the change in material of silicon into Viton fluoro elastomer and then to save in time and high temperature to act a Viton rubber. The experimental study is carried out by a silicon and Viton fluoro elastomer for various parameters as following them , Hardness test , Bio material test , Drop weight test , Tensile strength , Impact test , Percentage elongation , Fatigue test , Force gauges , Plastic and rubber test. Compare for experimental test to silicon and Viton fluoro elastomer. The result shows that the Viton fluoro elastomer material is better than the silicon rubber for robot finger.**

***Index Terms*— Robot, Elastic finger, Soft contact, High temperature, Tensile strength, Contact pressure.**

I. INTRODUCTION

Robotics is the science of designing and building robots suitable for real-time applications. In automated industry robots are meant for performing multiple activities to assist man in a planned manner. The most typical anthropomorphic characteristics are found in the ‘robot arm’. The arm makes the robot ideally suitable for a variety of production works like material handling, machine loading, spot welding, spray painting and assembly. The end of arm or end effectors is the bridge between the robot and the environment. The end effecto r’s action will vary according to the task to be performed.

The most important task is to grasp and hold objects, which are to be transported from one point to another. Human hand is unrivaled in its ability to grasp and manipulate objects. A lot of study and analysis is being done to emulate the human grasping by robot fingers. Soft contact interaction is important in robot object gripping to imitate the structure of human finger, which consists of soft epidermis and a cutis layer. The design of gripper and gripping force calculation is an important task in end-effectors design.

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II. METHODOLOGY

Hardness is a resistance to deformation. Hardness more likely means the resistance to indentation. Hardness values of viton and silicon rubber are estimated using the durometer of ASTM D2240 type standardization is shown in Table 1.

Table 1. Hardness value

S. No.	Material type	Hardness (S)
1	Silicon rubber	65 BHN
2	Viton rubber	75 BHN

Table 2. Young’s modulus

S. No.	Material type	Young’s modulus MPa	Hardness (S)
1	Silicon rubber	4.43	65 BHN
2	Viton rubber	7.05	75 BHN

The objective of contact width parameter is to evaluate the growing contact area between the object (spherical shape) and the robot finger (viton rubber) with respect to the grasping force. This parameter is measured in the harness testing machine.

The load applied to the ball indenter is assumed as a grasping force to the robot finger to hold the object without slipping.

The experiment is conducted with different loads such as 50 N, 100 N and 150 N. These loads are selected from the catalog of the testing machine and the contact widths are evaluated for these loads. The results are given in Table 3.

Table 3. Contact Width

S. No.	Grasping Force (N)	Contact Width (mm)	Hardness (S)
1	50	3.89	65 BHN
2	100	4.59	75 BHN
3	150	5.25	

2.1 Finite Element Analysis

The present work aims to study the effect of load in the robot finger (viton rubber) for single asperity contact parameters under loading conditions. Sathish Gandhi et al

(2012) studied the Finite element analysis software 'ANSYS' (2004) is used to carry out the analysis with axisymmetric condition. In the present study it is assumed that the robot fingers are in the spherical shape. Hence hemi sphere model and quarter sphere model are considered for the analysis. The Finite Element contact model of a Rigid Sphere (RS model) against a deformable flat (viton rubber) is shown in Figure 2. For the RS-model contact analysis, the contact pair is created and confirmed between sphere and flat. The meshed model is shown in Figure 3. For this investigation element type plane 82, conta172 and target 169 are used. The nodes lying on the axis of the hemisphere are restricted to move in the radial direction.

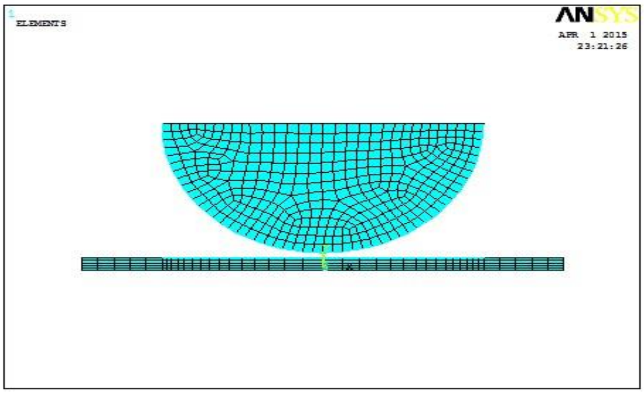

Figure 2.1: Finite Element Meshed Model

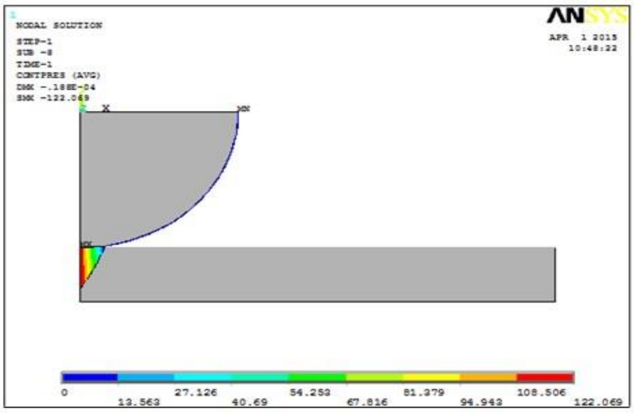

Figure 2.2: Contact pressure of 50N force

Figure 2.2 shows the contact pressure developed between the hemisphere and the flat plate for a grasping force of 50N. It is observed that the maximum contact pressure is developed underneath the contact area and the pressure is distributed within the contact region between the hemisphere and the flat. It shows that the pressure distribution profile is similar to that of the Hertz pressure distribution. The maximum value is 122.069 N/mm^2.

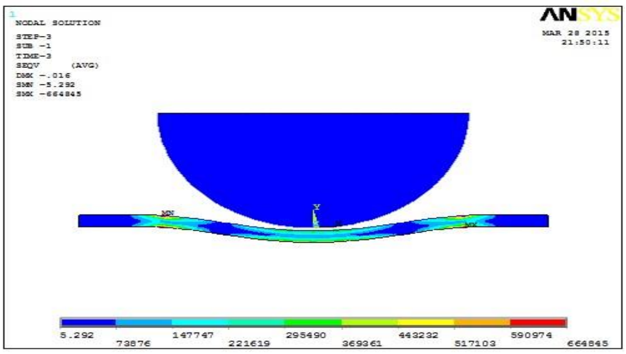

Figure 2.3: Von-Misses stress of 50N force

Figure 2.3 shows the Von-Misses stress developed in the flat plate for a grasping force of 50N. It is observed that the maximum stress is developed at the fixed end of the flat plate. Also it is shown that the stress value is more dominated in the bottom extreme portion of the deformed flat. The maximum stress value is 664845 N/mm2.

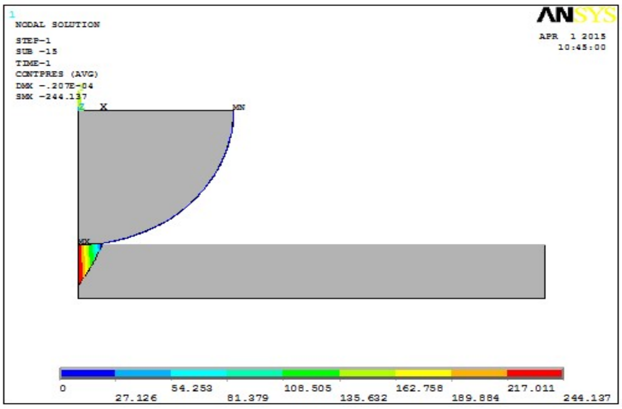

Figure 2.4. Contact pressure of 100N force

Figure 2.4 shows the contact pressure developed between the hemisphere and the flat plate for a grasping force of 100N. It is observed that the maximum contact pressure is developed underneath the contact area and the pressure is distributed within the contact region between the hemisphere and the flat. The maximum value is 244.127 N/mm2.

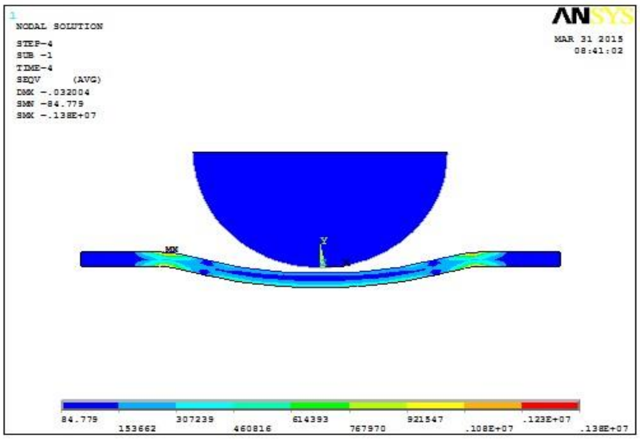

Figure 2.5 . Von-Misses stress of 100 N force

Figure 2.5 shows the Von-Misses stress developed in the flat plate for a grasping force of 100N. It is observed that the maximum stress is developed at the fixed end of the flat plate. It is also shown that the stress value is more dominated in the bottom extreme portion of the deformed flat. The maximum stress value is 0.138 x 107 N/mm2.

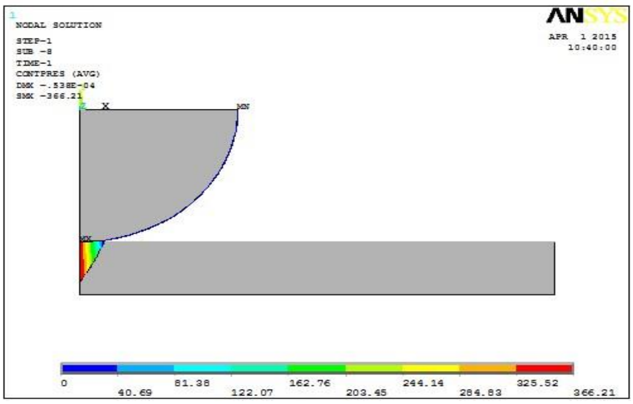

Figure 2.6. Contact pressure of 150 N force

Figure 2.6 shows the contact pressure developed between the hemisphere and the flat plate for a grasping force of 150N. It is observed that the maximum contact pressure is developed underneath the contact area and the pressure is distributed within the contact region between the hemisphere and the flat. The maximum value is 366.21 N/mm2.

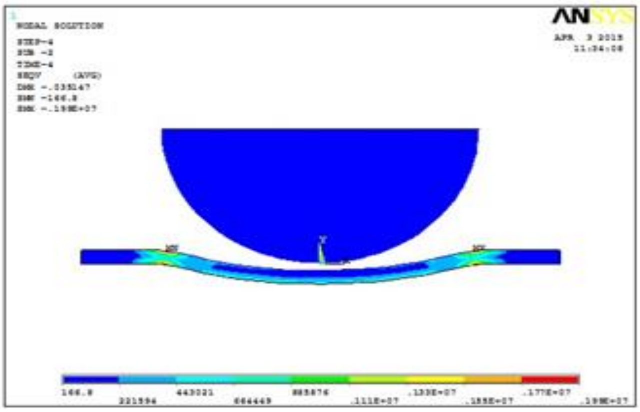

Figure 2.7 Von-Misses stress of 150 N force

It is observed that the maximum stress is developed at the fixed end of the flat plate. Also it is shown that the stress value is more dominated in the bottom extreme portion of the deformed flat. The maximum stress value is 0.199 x 107 N/mm2.

III. Results and Discussion

The study is conducted for Silicon rubber and viton rubber to determine the suitability of robot finger for soft handling and to withstand the higher temperature. Hence for the study, the experimental and simulation works are carried out to determine the various parameters such as hardness, Young's modulus, tensile strength, elongation (at break), contact width, contact pressure and Von-misses stress.

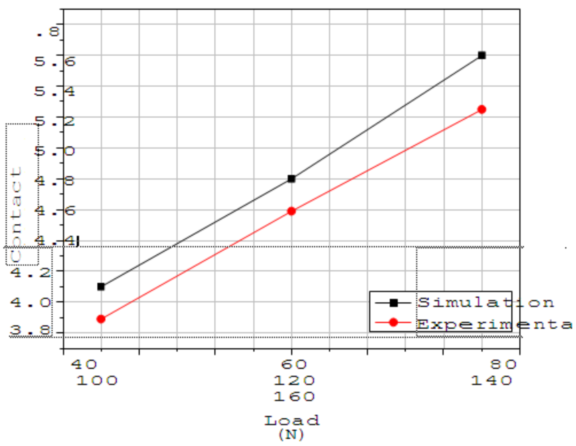

Figure 3.1 Von-Misses stress of 150 N force

Table 3.1: Result of experimental work

S.No.	Properties	Silicon Rubber	Viton Rubber
1	Hardness	65	75
2	Tensile strength (in N/mm^2)	5.20	8.46
3	Elongation (at break), %	162.28	203.68

It is observed that the property of viton rubber is better than the silicon rubber. Hence for further study the viton rubber is considered and the simulations are carried out for different properties like contact width, contact pressure and Von-misses stress.

Table 3.2: Result of simulation work

S. No.	Load (N)	Contact pressure (N/mm^2)	Von-misses Stress (N/mm^2)
1	50	122.069	664845
2	100	244.137	0.138 x 10^7
3	150	366.210	0.199 x 10^7

As shows that the contact pressure and Von-misses stress developed in the model of robot finger and the holding object. The results are obtained for different grasping forces. It is observed that the contact pressure and the Von-misses stress are gradually increasing on increasing the grasping force. The simulation results show the substantiation for the model developed for robot finger and the object.

IV. Conclusion

This paper is concerned with the the various rubber materials have been studied for robot finger for handling the object without any damage. The experimental study is carried out for the selected viton (FKM) and silicon rubber materials. In the experimental study, the various parameters like hardness, tensile strength, Percentage elongation (at break) and contact width are estimated for both viton and silicon rubber materials. The simulation study has been carried out in the 'ANSYS' software. The contact simulation study is carried out for viton (FKM) rubber material and the various parameters such as contact pressure and equivalent stress are determined for different grasping force. From the experimental results it is identified that the viton rubber is softer than the silicon rubber and also it can withstand higher temperature. Hence, it is concluded that the viton rubber is an alternate soft material for robot finger to handle the object in a soft manner without any damage.