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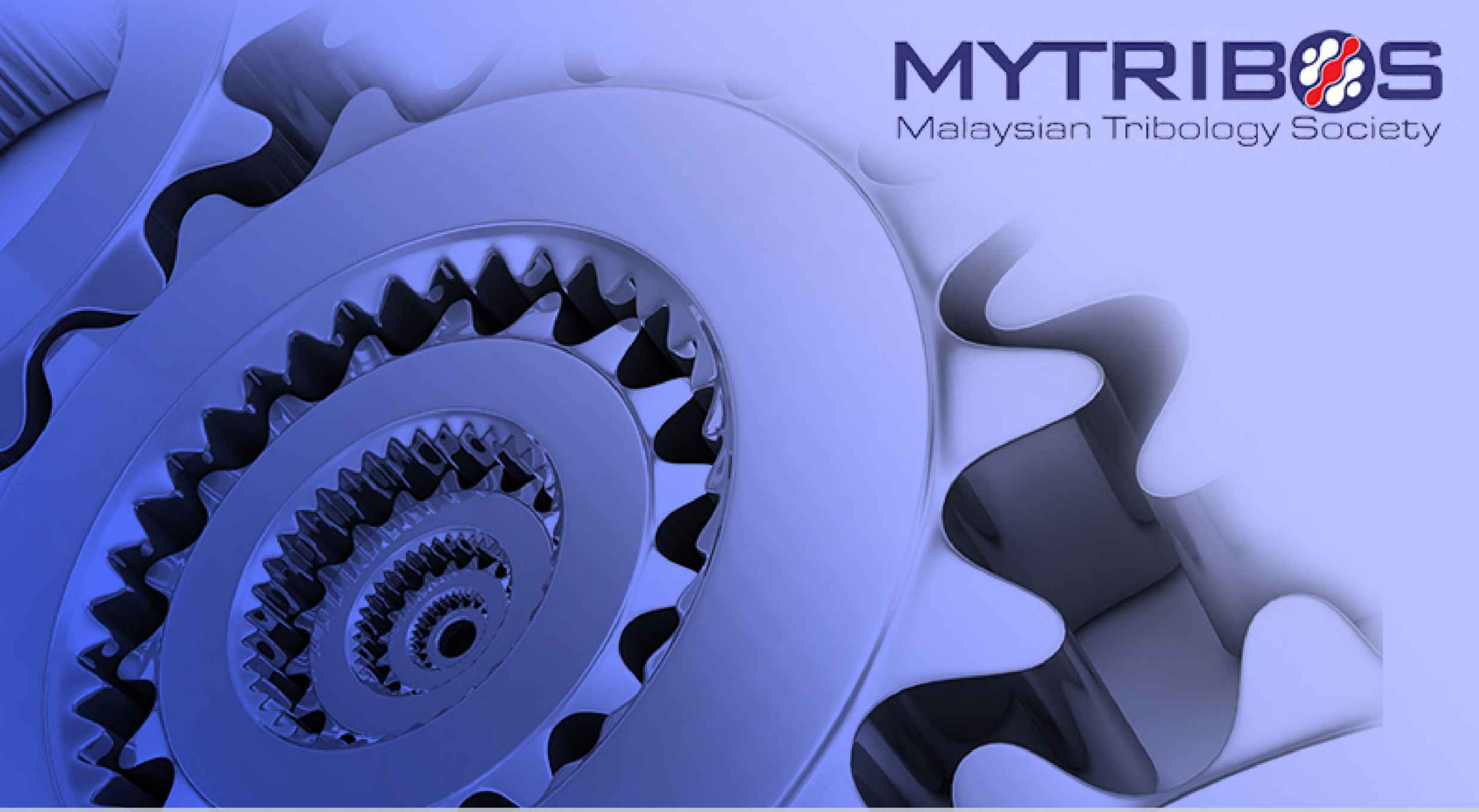

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FOREWORD BY THE EDITORS-IN-CHIEF

It is our great pleasure to welcome you to the Malaysian International Tribology Conference 2015 (MITC2015). This year's conference continues its tradition of being the premier forum for presentation of research results and experience reports on leading edge issues of Tribology, including models, systems, applications, and theory. The mission of the conference is to share novel findings, solutions that fulfil the needs of heterogeneous applications and identify new directions for future research and development. MITC2015 gives researchers and practitioners a unique opportunity to share their perspectives with others interested in the various aspects of Tribology.

The call for papers attracted 179 submissions from different continents: Asia, Europe, Australia, Africa and America. After a peer-review process, the editors accepted 159 papers that cover a variety of topics, including Bearing Design and Technology; Biotribology; Contact Mechanics; Friction and Wear; Fuels, Lubricants and Lubrication; Green Tribology; Surface, Coatings and Interface. This open access proceedings can be viewed or downloaded at http://mytribos.org/proceedings/mitc2015. We hope that these proceedings will serve as a valuable reference for researchers and tribologists.

We also encourage attendees to attend the keynote and invited talk presentations. These valuable and insightful talks can and will guide us to a better understanding of the future.

Putting together MITC2015 was a team effort. We first thank the authors for providing the content of the programme. We are grateful to the organising committee and the publication committee, who worked very hard in reviewing papers and providing feedback for authors. Finally, we thank the hosting organisation; Universiti Teknikal Malaysia Melaka and Malaysian Tribology Society (MYTRIBOS), our generous sponsors, our industrial partners, our reviewers and our universities, the place of intellectual repose, who supported us in our scholastic endeavours and inspires us to greater heights of achievements.

We hope that you will find this programme interesting and thought-provoking and that the conference will provide you with a valuable opportunity to share ideas with other researchers and practitioners from institutions around the world. Last but not least, let us endeavour to continue with our efforts for the advancement of our discipline.

Thank you.

Mariyam Jameelah Binti Ghazali
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Finite element modeling of the contact between an insole shoe and a ballnose cutter milling

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Keywords: Insole; FEA; ballnose indenter

ABSTRACT – Manufacture process of an insole shoe is quiet challenging. The most problem that frequently encountered is the contact between the cutter milling and the insole material. This paper studied such contact by finite element analysis. The results were presented in the form of von Misses stress distribution as a function of the studied contact parameters.

1. INTRODUCTION

Scientists have shown that biomechanical factors have an important role in etiology, treatment, and foot abnormality prevention. Therefore, it is important to understand biomechanics related to normal foot before foot orthotics or apply surgery intervention. Internal stress, leg and ankle stress information is important in improving knowledge about biomechanical behaviors from ankle areas. Direct biomechanical parameter measurement is hard to get the right size of feet. Otherwise, with CAD Orthotic technology, 3D Scan Human Foot, and Finite Element Model will produce a comprehensive computation model.

Problems that often arise in shoe industries which particularly produce insole shoe with the customer's foot size is how to get insole shoe in EVA rubber material included in viscoelastic material category that will be easy to form in CNC machine. To solve the problem, Finite Element is needed until we have EVA rubber materials. In general the steps of insole shoe process are shown in Figure 1.

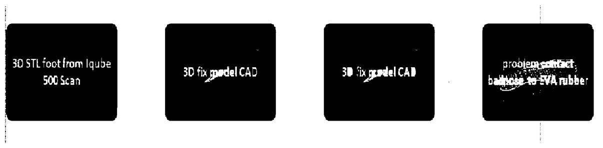


Figure 1 Insole shoe process steps.

The objectives of this study are to identify and examine mechanical characteristics in EVA rubber material insole shoe. This paper will analyze variations in the number of layers of rubber material are machined and variations in cutter milling indenter diameter to get maximum stress curve with load variation from 0 to 400 N.

2. METHOD

Finite Element Analysis which will be developed in this paper employing Abaqus 6.13 software to set SEF model in viscoelastic rubber material [1]. Based on the SEF work of Cheung and Zhang [2], Nora_SLW material and the Constant of C_{01} and and C_{20} of SEF Mooney-Rivlin will be used as a reference. The SEF Mooney-Rivlin for EVA rubber material is assumed as an incompressible material and determined uniaxial test until 15 MPa stress and 400% strain.

The Finite Element Analysis (FEA) model of Cheung and Zhang and [2] Tian and Saka [3] were adopted for modeling the contact system. Figure 2 shows the FEA model for the contact system between the ballnose and the viscoelastic material.

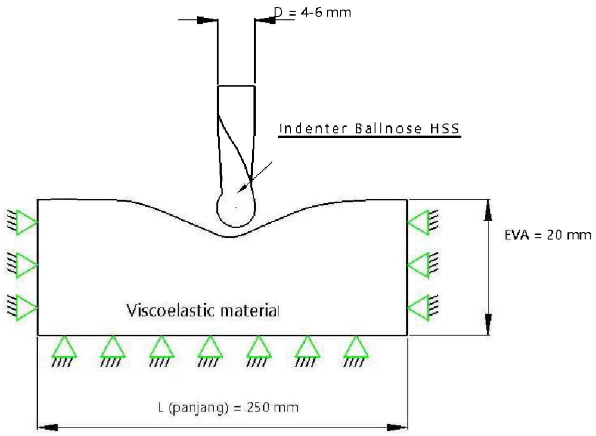


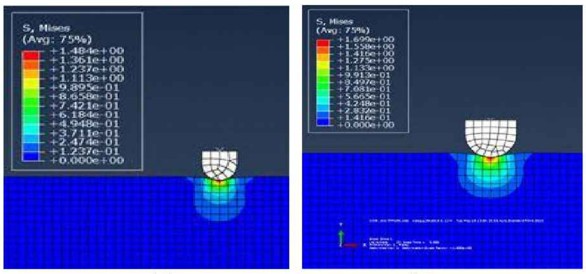
Figure 2 Contact model between a HSS ballnose indenter on a viscoelastic material.

In Figure 2 the rigid material of ballnose cutter milling will press the EVA rubber material in insole shoe manufacturing process. Thickness of the viscoelastic EVA material was varied. The boundary conditions of the contact system can be seen in detail in this figure. The deformable viscoelastic material was made by CNC milling which has dimension of 150 mm length, 30 mm width, and 20 to 40 mm thickness. The diameter of ballnose of 4 mm and 6 mm were employed for the rigid indenter.

The results will be presented in form of von Misses stress as a function of the variation of several parameters such as ballnose diameter and viscoelastic material thickness.

3. RESULTS AND DISCUSSION

Figure 3 shows an example result of the distribution of von Misses stress on the single layer EVA viscoelastic material with 20 mm thickness. In this figure, the von Misses stress distribution for EVA rubber material indented by the HSS ballnose indenter of 4 mm diameter (Fig. 3(a) and of 6 mm diameter (Fig. 3(b)) are presented. The maximum von Misses stress of 1.70 MPa was observed at 400% strain for the 6 mm diameter the ballnose indenter.



(a) (b)

Figure 3 The von Misses stress distribution of EVA rubber material indented by the HSS ballnose indenter with the diameter of: (a) 4 mm and (b) 6 mm.

Results of the relation of the stress and strain for several viscoelastic materials are presented in Figure 4. It shows that at the beginning of the stress-strain curve (from stress of 0 to 2.3 MPa) the EVA material and the Nora_SLW SEF is almost exactly the same. After that, the curves starts to deviate. The stress value increases as an increse of the strain value and the maximum stress is attained at the maximum strain for both the viscoelastic materials. The EVA rubber material has the maximum stress value of 7,67 MPa (about 10% less than Nora_SLW material). However, the difference between the EVA rubber material and the Nora_SLW material is almost contact and shows a similar trend.

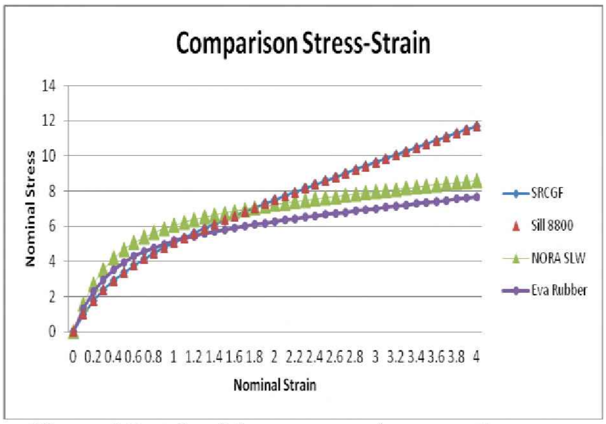


Figure 4 Result of the stress-strain curves for some observed viscoelastic materials.

4. CONCLUSION

Study the contact between a hard ballnose indenter and a deformable viscoelastic materials has been performed. Results showed that behaviour of SEF in EVA rubber material has similarity with the developed FEM model. The von Misses stress distribution is very usefull as the indicator for the studied contact parameters.

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