Rubber Research Capabilities and Facilities @ USM

Kami Memimpin *We Lead*

- **Established as the second university in the country in 1969.**
- **USM has been conferred the Research University status since 2006 and has been able to position itself to be a highly respected Higher Learning Institution nationally, regionally and globally.**
- **USM is the only Malaysian University conferred APEX status by the Malaysian Ministry of Higher Education since 2008.**
- **To be a university that provides distinguished quality education and research that is inclusive, innovative and sustainable**
- **USM aims to be among the top in the world for subject rankings.**

- **Second** out of **20** public universities in Malaysia
- Established in **1969**, the second oldest university in Malaysia

- **The first and only APEX university in Malaysia**
- **One of the five** research universities in Malaysia
- **One of the leading** universities in the country

- **27** Academic Schools (1 Graduate School of Business)

- **18** Centres of Excellence (CoE) and **3** Higher Institution Centres of Excellence (HiCoE)

- **About 2000** academic staff

- Student population of **about 30,000**

- Offers undergraduate & postgraduate programme (by research, coursework & mixed mode)

- **Campuses:**
  - Main Campus – Penang *(253.98 hectares)*
  - Engineering Campus *(72.84 hectares)*
  - Health Campus *(87.62 hectares)*
  - Advanced Medical and Dental Institute *(141.7 hectares)*
  - Offshore program in Belgaum, Bangalore, India
  - Kuala Lumpur City Venture

Main Campus Minden
246.78 Hectares
+CEMACS – Teluk Bahang

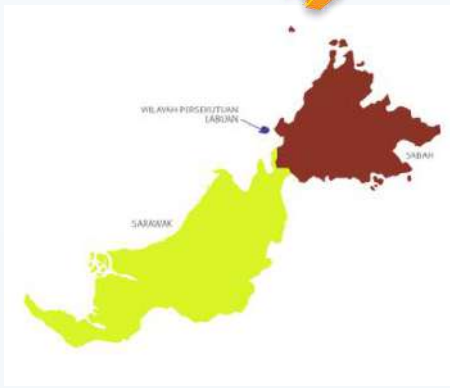
Sains@USM Bukit Jambul
13.9 Hectares

Engineering Campus Nibong Tebal
46.65 Hectares

Bertam
45.65 Hectares

800 bedded hospital

Health Campus Kubang Kerian
95.81 Hectares



USM CAMPUSES

Vision

- **Transforming higher education for a sustainable tomorrow**

Mission

- **USM is a pioneering, trans-disciplinary research intensive university that empowers future talent and enables the bottom billions to transform their socio-economic well-being**

26 SCHOOLS & 1 HOSPITAL

- SCHOOL OF MEDICAL SCIENCES
- SCHOOL OF DENTAL SCIENCES
- SCHOOL OF PHARMACEUTICAL SCIENCES
- SCHOOL OF HEALTH SCIENCES

- SCHOOL OF CHEMICAL SCIENCES
- SCHOOL OF BIOLOGICAL SCIENCES
- SCHOOL OF PHYSICS
- SCHOOL OF MATHEMATICAL SCIENCES

- SCHOOL OF CIVIL ENGINEERING
- SCHOOL OF MECHANICAL ENGINEERING
- SCHOOL OF MATERIALS AND MINERAL RESOURCES ENGINEERING
- SCHOOL OF ELECTRICAL AND ELECTRONIC ENGINEERING
- SCHOOL OF AEROSPACE ENGINEERING
- SCHOOL OF CHEMICAL ENGINEERING

- SCHOOL OF SOCIAL SCIENCE
- SCHOOL OF MANAGEMENT
- SCHOOL OF HOUSING BUILDING AND PLANNING
- SCHOOL OF INDUSTRIAL TECHNOLOGY
- SCHOOL OF HUMANITIES
- SCHOOL OF LANGUAGE, LITERACIES AND TRANSLATION
- SCHOOL OF EDUCATIONAL STUDIES
- SCHOOL OF COMMUNICATION
- SCHOOL OF ARTS
- SCHOOL OF DISTANCE LEARNING (PPJJ)
- GRADUATE BUSINESS SCHOOL (GSB)
- SCHOOL OF COMPUTER SCIENCE

- HOSPITAL USM

Engineering Campus – eng@USM

Established in March 2001. Area of campus ***72.84 hectares*** *(320* acres)

Chronology of Engineering Campus

1972
- *The subject of electronic technology, polymer, material and mineral resources offered at the School of Applied Sciences at Main Campus*

1984
- *Engineering Science and Technology Program offered at School of Engineering & Technology Industry at Main Campus*

1986
- *Engineering program was first offered in Perak Campus, Ipoh, Perak*

1990
- *Ipoh Perak Branch Campus moved to the Campus of Sri Iskandar, Tronoh, Perak*

2001
- *Perak Branch Campus moved to Engineering Campus Transkrian, Nibong Tebal, Penang*

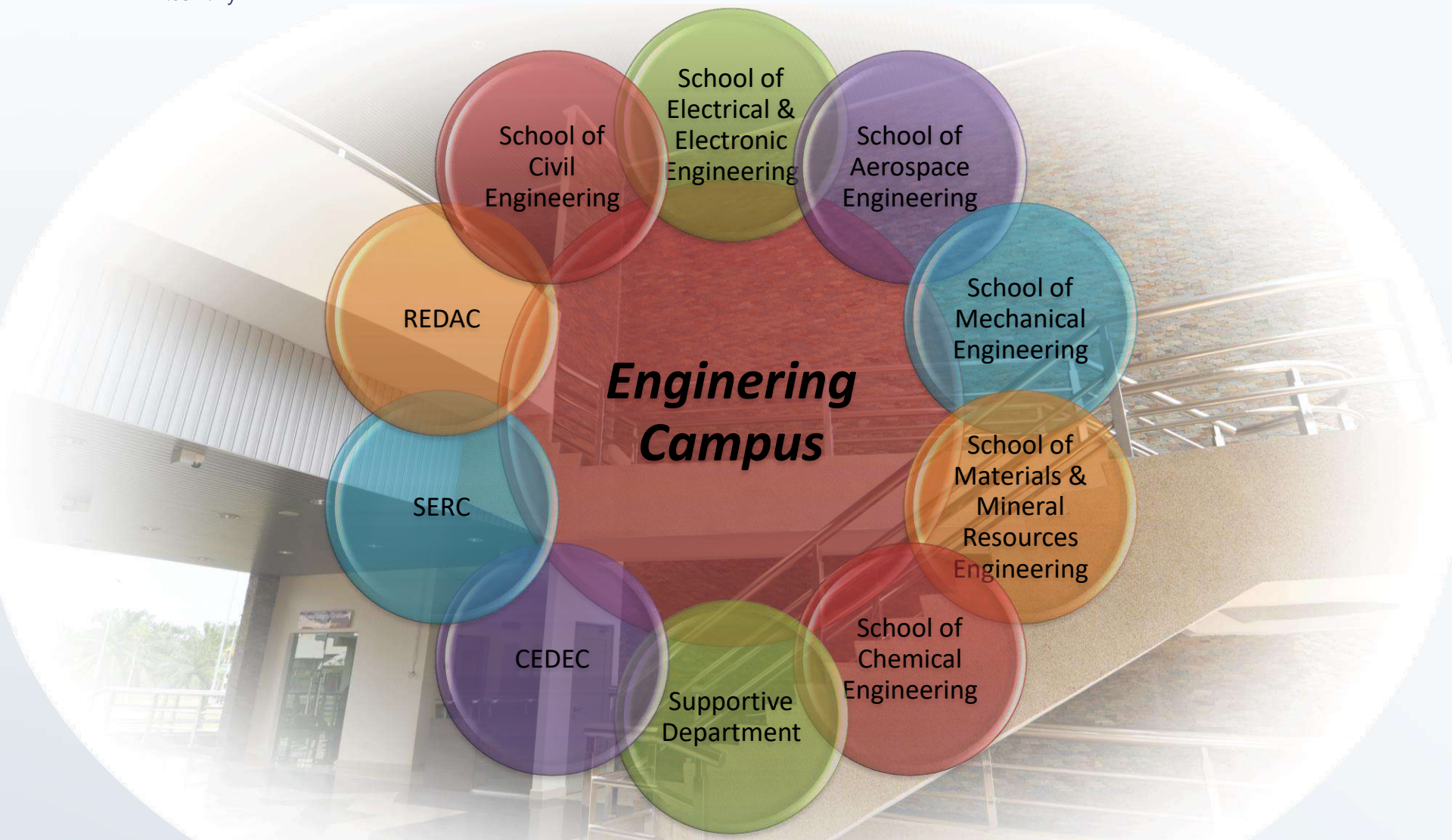
2007 — MRU

2008 — APEX F1

2014 — APEX F2

2015

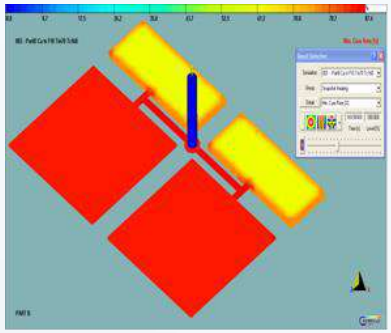
2025 World Class Research U

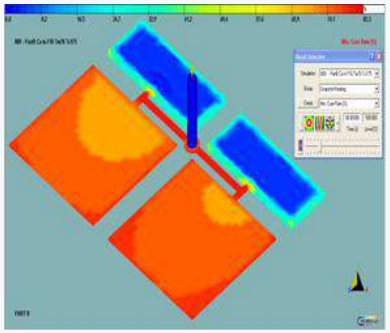

School of Civil Engineering
School of Electrical & Electronic Engineering
School of Aerospace Engineering
School of Mechanical Engineering
School of Materials & Mineral Resources Engineering
School of Chemical Engineering
Supportive Department
CEDEC
SERC
REDAC
Enginering Campus

ENGINEERING PROGRAMMES IN USM

- **6 Engineering Schools** offering **11 programmes** with each giving a degree in Bachelor of Engineering (Honours) and **accredited by Board of Engineers** and **accepted in Washington Accord Members**
- The Programmes are :
  - **Materials Engineering**
  - **Polymer Engineering**
  - **Minerals Resources Engineering**
  - **Aerospace Engineering,**
  - **Mechanical Engineering**
  - **Manufacturing Engineering**
  - **Chemical Engineering**
  - **Civil Engineering**
  - **Electrical Engineering**
  - **Electronic Engineering**
  - **Mechatronic Engineering**

RUBBER RESEARCH INFORMATION FROM USM





RESEARCH AIMS

- To enquire fundamental understanding and develop the research and development of synthetic and natural rubber latex and rubber for industry, environment, and daily applications.

- To produce high performance latex and rubber properties that can be degradable with low in cost and easy production process.

- To provide technology know how for latex/ rubber in rubber processing and solved the industrial problems

a) Rubber blend

Research are focus on production and development of various rubber blends with plastics, rubber, waste materials and etc to meet several applications in industry and daily life.

(b) Thermoplastic Elastomer

Research are focus on production and development of high performance TPE to meet several industrial and daily life applications (e.g. : shoe sole formulation, automotive components). The research also focuses on synthesizing the possible fillers for TPE's enhanced performances.

(c) Rubber Foam

Research are focus on production and development of range of Natural Rubber foams from conventional rubber compound formulations which have been tailored to provide essential foam features for shock absorption and sound proofing applications.

(d) Rubber Composites & nanocomposites

Research are focus on production and development of various rubber composites and nanocomposites using natural fillers (sago starch, banana powders, soy powder), recycled fillers (fly ash, paper sludge, rice husk etc) and nanofillers (nanosilica, halloysite nanotube (HNT), maerogel to meet several applications in industry and daily life.

(e) Rubber Recycling

Research are focus on production and development of various products using recycled materials include plastic bottle, NBR gloves, latex waste etc to reduced the solid waste and to low the product cost with acceptable performance.

(f) Rubber Engineering

Research are focus on development of various products for engineering applications with involved the selection of new materials, design improvement and proof of concept.

(a) Biodegradable Latex Films

Research are focus on synthesizing Natural rubber latex (NRL) and synthetic latex films which able to biodegrade upon disposal by introducing decomposable materials into NRL/synthetic latex compound

(b) Laminated Latex Films

Research are focus on producing laminated latex films via dipping or casting method with targeted applications (mold cleaning, multiple dipping industrial gloves etc.)

(c) Recycling of waste Latex

Research are focus on recovery of latex product waste (e.g. : gloves, condoms, balloons and etc) to be use as substitute materials for distinct applications. The research also focus on recovery of waste latex compound from industry to be use as fillers and laminated films

(d) Click Chemistry

Click chemistry is suggested not just for sulphur-free vulcanization (curing) alone but also to replace and to reduce some of the ingredients. By avoiding sulphur, the gloves require less washing steps, thus increasing the production rates.

POLYMER PROCESSING EQUIPMENTS

PHYSICAL TESTING EQUIPMENT

HARDNESS TESTER

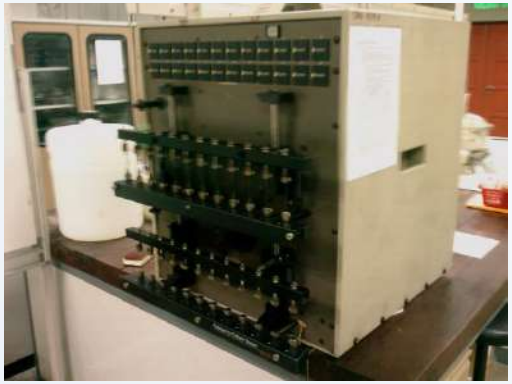
UNIVERSAL TESTING MACHINE

RUBBER EQUIPMENTS

Compression Moulding

Two Roll mill

MDR



Fatigue Test

ANALYSIS EQUIPMENTS

DENSITY METER

SCANNING PROBE MICROSCOPE

IMAGE ANALYSER

OPTICAL MICROSCOPE

FESEM

PORTABLE XRD

X-RAY EQUIPMENTS

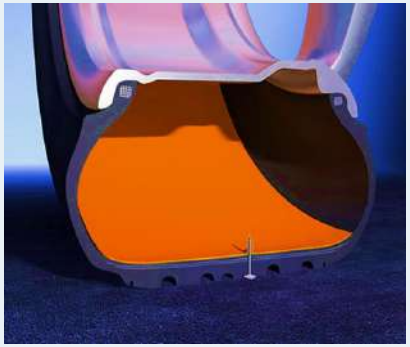
Related Research Project on Rubber

Name	Assoc. Prof. Ir. Dr. Nadras binti Othman (Email: srnadras@usm.my/013-5813137)
School	School of Materials and Mineral Resources Engineering
Title of Research 	1. Fundamental Research Grant Scheme (FRGS) Fasa 1/ 2016, Understanding of photodegradation mechanism in NR latex with the incorporation of surfaced bi-metal oxide, MOSTI, RM 118,800.00, 1st August 2016/3 years, (Project Leader) **2. MREPC Industrial Linkages Fund (Matching Grant), 2018, Malaysian Green Pre-cured Tire Tread Liner, MREPC & Eversafe Rubber Works Sdn Bhd.,** RM 551, 000.00, 1st September 2018/3 years, (Deputy Project Leader - USM, Project Leader – Eversafe Rubber Works (M) Sdn Bhd 3. Fundamental Research Grant Scheme (FRGS) Fasa 1/ 2020, Abrasion mechanisms modeling of natural rubber(nr) counter surface interaction on different geometry and morphology textures, RM123,360.00, 01/11/2020-31/10/2022 (As Co-researcher) (Project Leader: Dr. Ramdziah binti Mohd Nasir, School of Mechnical Engineering, USM)

Related Research Project on Rubber

Name	Prof. Dr. Azura Binti A. Rashid (Email: srazura@usm.my/0195577884)
School	School of Materials and Mineral Resources Engineering
Title of Research 	**1. Research University Grant (RUI)** Development of Antimicrobial Latex Films for Stethoscope Diaphragm Cover Application via Latex Dipping Process USM RUI, RM58,000.00, 01/08/2020-30/07/2023 (Project Leader) **2. MREPC Industrial Linkages Fund (Matching Grant), 2020,** Superhydrophobic Latex Coating, MREPC , **RM59,000.00,** 01/12/2020-30/11/2022, (Project member) 3. **Fundamental Research Grant Scheme (FRGS)** Fasa 1/ 2020, The mechanism of ionic liquid crosslinking on cellulose based carboxylated nitrile butadiene rubber latex films FRGS, RM 138,300.00, 1/11/2020-31/10/2023, (Project Leader)

Related Research Project on Rubber

Name	Prof. Madya. Dr. Raa Khimi (Email: raakhimi@usm.my/0194647498)
School	School of Materials and Mineral Resources Engineering
Title of Research	**ROOM TEMPERATURE SELF-HEALING NATURAL RUBBER**
Synopsis 	• Self-healing Rubber engineered in this invention has the capability to repair itself and to recover functionality when it is damaged without the need for detection or repair by manual intervention of any kind. • The material was developed based on natural rubber and vulcanized using self-developed self-healing curative agent. • This makes possible to immediately transfer the technology to industry rendering high added value products. 
Main Output/Outcome	Puncture proof self Healing tape for motorcycle tyre 

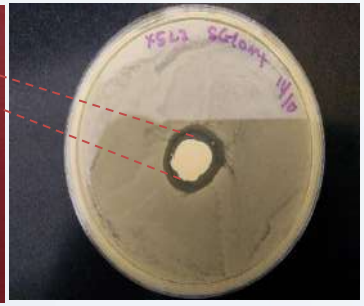
Related Research Project on Rubber

Name	Prof Ir Dr Srimala Sreekantan & Dr Ong Ming Thong
School	Materials & Mineral Resources Engineering and INFORMM
Title of Research	Antimicrobial (AM) Gloves and Polymers
Synopsis	The aim of our project is to develop antimicrobial and antiviral active ingredients in various form (solution, powder and polymer blends) to be incorporated into various materials to combat various pathogens that harms humans life.
Main Output/Outcome	AM compounding blend and active ingredients
Facilities	AM active ingredient manufacturing facilities and antimicrobial testing facilities

FOR ANTIMICROBIAL GLOVES

Coagulants with AM active ingredients

Samples



Inhibit zone around the sample

ANTIMICROBIAL MASTERBATCH FOR VARIOUS POLYMER APPLIANCE

Process: Scalable process to industrial scale

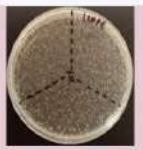
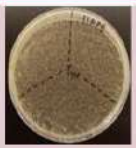
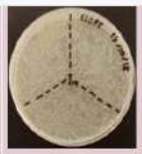
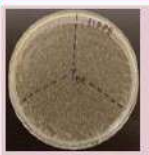
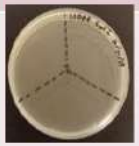
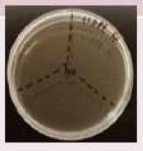
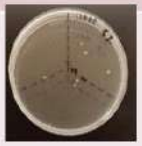
Product:

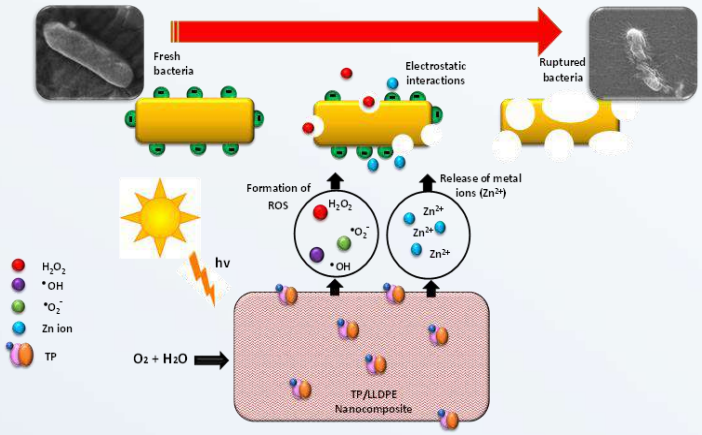
Antimicrobial polymer composite masterbatch

Efficacy :

kills 99% MDR foodborne pathogens

Compliance: PASS the European Commission Regulations (EU) No 10/2011

Microbes	E.coli ATCC 25922	K.Pneumoniae ATCC 700603	Shigella Flexneri ATCC 12022	S.Aureus ATCC 29213	B.Subtilis ATCC 6633	B.Cereus ATCC 14579
Control (Bare PE)						
POLYSAFE (Prototype Developed)						



OUR ACTIVE INGEDIENT has passed several European norm tests (EN-tests) and ISO test conducted on the following organisms.

Fungus

EN 13624, *Aspergillus brasiliensis ATCC 16404*
EN 13624, *Candida albicans ATCC 10231*
EN 13624, *Aspergillus Niger ATCC 16404*

Bacteria

EN 13727, *Pseudomonas aeruginosa ATCC 15442*
EN 13727, *Staphylococcus aureus ISI 835*
EN 13727, *Staphylococcus aureus ATCC 25923*
EN 13727, *Listeria monocytogenes ISI 127*
EN13704, *B. Subtilis ISI 1384 spores*
ISO 13727, *Pseudomonas Aeruginosa ATCC 15442*
ISO 13727, *Enterococcus Hirae, ATCC I0541*
ISO 13727, *Escherichia Coli, ATCC 8739*
ISO 13727, *Staphylococcus Aureus, ATCC 6538*
ISO 13727, *Pseudomonas aeruginosa, ATCC 9027*
ISO 13727, *Salmonella Typhii ATCC 49416*

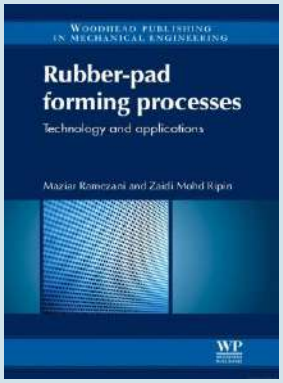
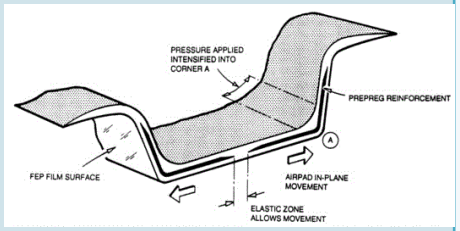
Viruses

EN 14476, *Human coronavirus ATCC VR-740*
EN 14476, *Murine norovirus FLI-RVB-0651*
EN 14476, *Poliovirus type 1 NIBSC-01/528*
EN 14476, *Vaccinia virus ATCC VR-1508*
EN 14476, *Adenovirus Type 5 ATCC VR-5*
EN 14476, *Enterovirus EV-71/4643/MP4*
EN 14476, *Influenza A/WSN/33 (H1N1)*
EN 14476, *Influenza B/70555/05*

Related Research Project on Rubber

Name	Prof. Dr. Zulkifli Bin Mohamad Ariff (Email: zulariff@usm.my)
School	School of Materials and Mineral Resources Engineering
Title of Research 	**USM's Short Term Grant** A Study on Production and Optimisation of Rubber Foam from Natural Rubber (Principal Investigator) **MOSTI ScienceFund** Development of Natural Rubber Foams and Characterisation of Its Structure-Properties Relationship for Sound Proofing and Shock Absorbing Application (Principal Investigator) **USM Research University (RUI) Grant** Development of Water Blown Natural Rubber Foam Through Microwave Processing Approach (Principal Investigator)

Related Research Project on Rubber

Name	A.Prof. Ir. Dr. Abdus Samad Mahmud *abdus@usm.my*
School	Mechanical Engineering
Title of Main Research	Skin tribology study of rubber glove in terms of friction to skin, heat transfer and tactile (Leader: Prof. Dr. Zaidi)
Synopsis of the other on-going and completed projects 	We have developed a technique to measure loss factor from impact test (project completed) – Prof. Dr. Zaidi We used rubber mount to reduce vibration transmission to hand (project completed) - Prof. Dr. Zaidi Recycle rubber wear (project completed) – Dr. Ramdziah Numerical modelling of latex-dipping process in the production of medical gloves (on-going) – Dr. Fikri Rubber composite manufacturing for structural damping and elastic zone deflection (on-going) – Dr. Hafiz 
Main Output	Product in market, prototype, papers, medals, postgrad.
Facilities	Tribometer, vibration lab, TGA, DSC, SEM, UTM, vacuum furnace, manufacturing workshop, Alicona, Abaqus, Ansys

Related Research Project on Rubber

Technique to measure loss factor from impact test (project completed) – Prof. Dr. Zaidi
We used rubber mount to reduce vibration transmission to hand (project completed) - Prof. Dr. Zaidi *mezaidi@usm.my*

Recycle rubber wear (project completed) – Dr. Ramdziah *ramdziah@usm.my*

Numerical modelling of latex-dipping process in the production of medical gloves (on-going) – Dr. Fikri *afikri@usm.my*

Rubber composite manufacturing for structural damping and elastic zone deflection (on-going) – Dr. Hafiz *mhafizhassan@usm.my*

Scope of Collaboration

- Research collaboration with outcomes such as co-supervision, joint publication, joint application of international grants or development of joint degrees
- Joint facility/lab program
- Joint seminar/workshop/conference
- Joint industry/international grant applications
- Student/staff exchange program

Kami Memimpin *We Lead*

Thank you