

# Dr. Shahid Mehmood

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Flat 3, 9 Richmond Road  
Uplands, Swansea  
SA2 0RB, UK

**Mobile:** +44 7923 345632  
**Email:** shahid1407@hotmail.com

**SUMMARY:** I have keen interest in managing material related activities such as design, manufacture and testing of a wide range of engineering materials, in particular, fibre filled polymer composites, polymers, metals/alloys, metallic powders, and biomaterials. I have applied my knowledge to establish solutions to industrial problems / research questions in the fields such as failure analysis and aspects of metallurgical engineering, including benchmarking, manufacturing, product development and material quality control. In addition, I have analysed materials and designs using scientific experiments / computational models (ANSYS) to predict the performance of materials used for product design and part quality enhancement and finally disseminated the findings to produce knowledge. My industrial and academic experiences have been recognised through peer-reviewed research articles, reports and presentations.

## WORK EXPERIENCE

### **Senior Metallurgist and Composites Specialist / Managing Director - Mughal Materials Engineering**

Swansea, UK

June 2017 - Present

We are based in Swansea, in the UK. A consultancy company fully committed to help you grow your business by providing advice on material selection and manufacturing processes, through consideration of the material structure-property relationship. We are able to offer advice regarding a wide range of materials, including: polymers and their composites; metals, alloys, and their powders. We believe that characterising internal microstructure is the gateway to achieving optimum material properties and processing conditions for optimised product performance. We are not a standard material testing company, it is our focus to work with you to help you understand your challenges and then overcome them allowing your business to grow.

Please do contact us to discuss your specific needs; we will endeavour to reply within 24 hours or less. Mobile: +44 7923 345632 or Email: info@mughal-materials.com

### **Lab Manager – Metals and Composites Testing (UKAS/NADCAP accredited)**

*Exova Bridgwater, UK*

*Jan 2017 – June 2017  
(Made redundant due to  
decline in the business  
activities)*

- In this role, I managed a team of test technicians, technologists, metallurgists and engineers to deliver short term (2-3 days turnaround) and long term testing projects (a few months to several years) within strict deadlines and budgets to maximise the business revenue.

### **Research Associate – Filament Winding Composite Materials**

*The Northern Ireland Advanced Composites and  
Engineering Centre, UK*

*2016 - 2017*

- In this role, I have designed/manufactured/tested composite tubes for clients in aerospace/defence sectors (Thales and CCP Gransden) to replace metallic materials in these structures for enhanced performance and weight saving.
- I prepared proposals for collaborative R & D projects between academia and industry. Subsequently, I breakdown the broader project objectives into small executable activities which were assigned to the technicians and machine operators with well-defined deadlines.
- Using simulation-based tools, I analysed various designs of composite tubes to achieve required product standards as demanded by our customers.
- In order to achieve the technical and financial goals of the project I acquired various resources such as raw materials, processing machinery, testing equipment and simulation software and undertook necessary, design, manufacture and test related work.
- On quarterly basis I informed project stakeholders of the project progress in the form of Gantt charts, project budget and project deliverables. .
- Worked closely with finance department to secure consistent supply of required raw materials and tested them in accordance with standard test procedures.
- Also carried out cost-benefits analysis of various manufacturing processes for economic benefits to the companies.

## **Project Officer**

*College of Engineering, Swansea University, UK*

*2011 - 2015*

- I worked at Swansea University as a Project Officer for an European funded project 'Advanced Sustainable Manufacturing Technologies' (ASTUTE) for providing solutions to industrial partners of their manufacturing related challenges through innovation in materials, design and processes.
- As a metallurgist/materials expert, I characterised a wide range of metals and materials in various physical forms to attain their mechanical and physical properties.
- I incorporated material properties into computational models for design and process optimisation and investigated failure causes of products and materials.
- Managed materiel testing lab at Swansea University for the calibration, maintenance and promoting the safe and clean practice of the equipments used in metallurgical analyses including, moulding machines, polishing machines, optical microscope and hardness testers

## **Research Assistant**

*Risø National Laboratory for Sustainable Energy,  
Denmark*

*2009 - 2010*

- Here, I carried out experimental work as part of FP7 R&D projects which includes manufacture and testing of two types of composites: flax fibre-thermoplastic polyester composites and steel wires reinforced thermoset polyester composites
- Also performed analysis and interpretation of results, and wrote reports, presentations and international publications

## **Production and Planning Manager**

*Grays of Cambridge (Pak) Ltd., Pakistan*

*2005 - 2008*

- I worked at Grays of Cambridge (Pakistan) Ltd as a Production and Planning Manager; a firm specialized in manufacturing of carbon/glass fibre-epoxy composite hockey sticks. Here I managed 175 workers/contractors in the factory and controlled variety of manufacturing processes including, pre-preg, lamination, moulding, curing, painting/decorating of composite materials.
- I planned and controlled production of prepregs from Carbon/Glass/Kevlar fibres using filament-winding process and epoxy resin and subsequent manufacture of composite hockey sticks using inflate bladder process.
- I optimised the processing parameters of the filament-winding machine to attain a fibre volume fraction, which resulted in optimum mechanical properties of the composites produced.

- I established processing standards for laminating prepregs and producing composite parts (hockey sticks) using inflate bladder process.
- I established recipes for PU and PVC based paints for colouring of hockey sticks and of their curing.
- I also troubleshooted aforementioned processes for debugging.
- I investigated the shock absorbing behaviour of the hockey sticks using high velocity impact rig and on the basis of these results, we optimised the nature of the fibre, fibre orientation and the ratio of fibre and resin in the prepregs and this eliminated the shock transferred to the arm of the player.
- I worked in close collaboration with one of German suppliers for the development of a competitive epoxy resin for the upgradation of the product quality at reduced cost. A range of experimental trials to optimise curing process and certify the product quality was conducted for the final approval of this new epoxy system.
- Worked closely with other departments such as purchase to secure consistent supply of required raw materials and tested them in accordance with standard test procedures. Liaise with finance department for the cost-benefits analysis and annual financial projections and communicated findings with the internal and external customers at annual review meetings to enhance product performance.

# SKILLS AND COMPETENCES

## Advanced Metals and Alloys

- Tensile and compression testing of additive layer manufactured 316 L Stainless Steel, Creep Testing of lead free solder alloys such as Tin, Silver and Copper based alloy
- Hardness testing of Al alloys and plain carbon steel using Brinell/Vicker and Shore Hardness tests
- Analysing customer parts (Aluminium, plain carbon steel, Ti, Ni-Cr-Co alloys) under SEM/EDX to investigate their chemical composition and microstructural features, such as porosity, grain size, coating thickness and morphology
- Studying effect of heat treatment on the development of various phases in Co-Cr alloys used for the manufacture of dental alloys
- Preparing the test specimens using metallographic procedures and examined the microstructure and internal features, e.g. porosity, inclusions, coating thicknesses using SEM and optical microscopy
- Using rheometers/SEM to investigate the feasibility of metallic powders (316 L Stainless Steel, 17-4 PH Steel, Copper, various grades of Co-Cr powders) to be used in Additive Layer Manufacturing (ALM) and manufacture products for aerospace and bio-medical applications.

## Thermoplastic/Thermoset Polymers

- Analysing polymers using FTIR methods to find their fingerprints.
- Analysing various thermoplastics, thermosets and elastomers using Differential Scanning Calorimetry to measure their useful physical characteristics such as glass transition, crystallinity, thermal conductivity and specific heat.
- Studying polymers, e.g. curing of epoxy-based composites, glass transition temperature in Nylon, Polyethylene and Polypropylene and hysteresis in Silicon based elastomers using Dynamic Mechanical Analysis

## Advanced Composites and Product Development

- Managing the design process of composite materials throughout the product life cycle and scaling-up materials and processes from coupon level concept to bulk manufacturing
- Very proficient in the use of common composite manufacturing processes such as Prepreg, Vacuum bagging, Resin transfer moulding, Filament winding, Inflate bladder moulding and when to use each method .
- Familiar with structural composite materials such as carbon, glass and aramid fibre, epoxy/polyester/polyurethane resin and core materials
- Developing lay-ups for structural and non-structural components using a variety of materials and substrates
- Investigating the relationship between lay-up design and composites mechanical properties
- Using X-ray, Ultrasound and imaging methods to quantify the nature of defects such as porosity and contaminants and fibre volume fraction

- Sound understanding of composite microstructure and relation to processing method
- Proficient in composite materials characterization methods and testing, e.g. Tensile, compression and shear testing of UD coupons of fibre-filled composites (Carbon-epoxy, steel-reinforced polyester, Flax/hemp-polyester composites) to investigate their load bearing capacity and performance
- Undertaking the preparation of composite samples for microstructural analysis using SEM/OM
- Using Archimedes method measured the density in flax/hemp-polyester, steel-polyester and carbon-epoxy composites to analyse fibre volume fraction and hence predicted mechanical performance in composites using rule of mixtures.
- Testing of composite tubes using four point bend/internal pressure tests
- Joining of composites-composites and composites-metals
- Delivered lectures to Master Level Students at Ulster University and Coached my colleagues at CCP Gransden in field of Composites Materials Science

### **Project and Manufacturing Management**

- Planning, implementing and tracking various activities at product development stage and routine quality control checks during production
- Compiling costing sheets for quotes
- Daily monitoring the available work force capacity and requirement of workforce at the production lines
- Developing, implementing and maintaining policies and procedures to reduce costs,
- Documenting important process and work instructions for the workers
- Providing support and leadership to ensure a smooth interface between departments and individuals regarding production plans, built programs and production related problem solving
- Co-ordinating with accounts department on matters involving, costing, stock control and forecasting and financial issues

### **Computational Modelling by Finite Element Analyses**

- Using Ansys Workbench to carry out creep and fatigue-based analyses of lead free solder joints in printed circuit boards and drop impact analyses of injection moulded PP customer's part
- Using Altair Hypermesh to mesh complex geometrical entities and optimize lay-up design and ply thickness for products made of layered based fibre composites
- Designing products using Autodesk Inventor/Solid works/Catia
- Imaging analyses with Image Pro to quantify porosity and inclusions in metallic alloys and fibre volume fraction in polymer-based composites
- Analysing environmental impact of various products from cradle to grave using Ecopackager
- Using Cambridge Engineering Materials Selector to select suitable materials for enhanced product performance
- MS Office/Latex/EnNote to write reports and presentations

### **EDUCATION**

- PhD Materials Engineering, Swansea University, UK, July 2016 (thesis available on demand)
- MSc Engineering Project Management, Bournemouth University, UK, 2005
- BSc Metallurgical and Materials Engineering, UET Lahore, Pakistan, 2004

### **PROFESSIONAL MEMBERSHIP**

- Prof Grad MIMMM, The Institute of Materials, Minerals and Mining (IOM3)
- Working towards CEng

### **AWARDS AND HONOURS**

- DFID Shared Scholarship awarded by ACU UK for MSc Engineering Project Management (18000 £)

- Gold Medal Award for my best overall performance in U.E.T. Lahore
- Summer school of composite materials for PhD level candidates at Århus University, Denmark, arranged by TERMA, August, 2010

## RESEARCH PUBLICATIONS

### Materials, Design and Failures

- Khaliq A, Rafiq M A, Ali H T, Ahmed F, **Mehmood S** and Ranjha S, Melt quality induced failure of electrical conductor grade aluminium wires, Journal of Mining and Metallurgy B, accepted October 2016.
- **Mehmood S**, Belblidia F, Davies H M, Arnold C, Khaliq A, Sienz J, Archer E, Davies J, An Investigation into failure analysis for injection moulded polypropylene sharps-bin by experimental material characterisation and computational modelling, in preparation for submission in Materials and Design Journal in December 2016.
- Eckermann J, **Mehmood S**, Davies H M, Lavery N P, Brown S G R, Sienz J, Jones A and Sommerfeld P, Computational modelling of creep-based fatigue as a means of selecting lead-free solder alloys, Microelectronics Reliability 54 (2014) 1235–1242
- Eckermann J, **Mehmood S**, Davies H M, Lavery N P, Brown S G R, Sienz J, Jones A and Sommerfeld P, Design for Reliability of Steering Power Module due to Design Consideration and Material Selection, Kess International Sustainable Design and Manufacturing, Cardiff, Wales, 28th to 30th April, 2014
- Eckermann J, **Mehmood S**, Davies H M, Lavery N P, Brown S G R, Sienz J, Jones A, Sommerfeld P. Computational modelling of creep-based fatigue as a means of selecting lead-free solder alloys EuroSime, 2013 at Wroclaw, Poland.
- Belblidia F, **Mehmood S**, Lee C H, Levatti H U, Sienz J, Gethin D T and Arnold C, Experimental and Numerical Investigations into Dynamic Loading of Rubber Compound. 23rd UK Conference of the Association for Computational Mechanics in Engineering at Swansea University, 2015.
- **Mehmood S**, Arnold C, Bould D, Lavery N P, Alston S, Sienz J, Pittman J, Cameron I and Davies D, Studying Microstructure and Crystallinity of Polypropylene in an Injection Moulded Medical Bin Lid, Kess International Sustainable Design and Manufacturing, Cardiff, Wales, 28th to 30th April, 2014

### Corrosion and Protection

- Yousef H N S, Cobley R J, Davies H M, James D M, **Mehmood S**, Sackett E, and Sienz J, Establishing a quantifiable tarnish timeline for comparison of anti-tarnish processes in metals, Published in February 2015 in Journal of Materials and Corrosion.

### Additive Layer Manufacture

- Cherry J A, Lavery N P, Davies H M, **Mehmood S**, Sackett E, Kenwood B, Brown S G R and Sienz J, Effect of hot isostatic pressing on the elastic modulus and tensile properties of 316 L parts made by powder bed laser fusion, Materials Science and Engineering A, Submitted in September 2016.
- Davies H M, **Mehmood S**, Khaliq A and Ranjha S A, Microscopic Analyses of 316 L Stainless Steel Powder from Additive Layer Manufacturing Process, Microscopy and microanalysis, in preparation for submission in December 2016.
- Cherry J A, Davies H M, **Mehmood S**, Lavery N P, Brown S G R and Sienz J, Investigation into the Effect of Processing Parameters on the Microstructural Evolution and Physical Properties in Additive Layer Manufactured 316L Stainless Steel, International Journal of Advanced Manufacturing Technology, Int J AdvManufTechnol, 76 (2015), 869-879.
- Levatti H U, Innocente M S, Morgan D, Cherry J, Lavery N P, **Mehmood S**, Cameron I and Sienz J, Computational Methodology for Optimal Design of Additive Layer Manufactured Turbine Bracket, Kess International Sustainable Design and Manufacturing, Cardiff, Wales, 28th to 30th April, 2014.

### Composite Materials

- Mustafa A, **Mehmood S**, and Madsen B, Effect of consolidation pressure on volumetric composition and stiffness of unidirectional flax fibre composites, Journal of Materials Science, 2013, 48 (10), 3812-3824
- Hanninen T, Thygesen A, **Mehmood S**, Madsen B and Hughes M, Mechanical processing of bast fibers: The occurrence of damage and its effect on fiber structure. Industrial crops and products, 39 (2012), 7-11
- **Mehmood S** and Madsen B, Properties and performance of Flax yarn/Thermoplastic polyester composites, Journal of reinforced plastics and composites, 2012, (24), 1746-1757
- Mustafa A, **Mehmood S**, Goutianos S and Madsen B, The effect of processing on defects and tensile strength of single flax fibers, 14th European conference on composite materials 7-10 June 2010, Budapest, Hungary
- **Mehmood S**, Khaliq A and Ranjha S, The use of post-consumer wood waste for the production of wood plastic composites: A review, 3rd International symposium on energy from biomass and waste at Venice, November 8-10, 2010

- **Mehmood S**, Khaliq A and Ranjha S, The use of post-consumer plastic waste for the production of wood plastic composites: A review, 3rd International symposium on energy from biomass and waste at Venice, November 8-10, 2010

## **ACADEMIC PRESENTATIONS**

- Keynote presentation - Computational modelling of creep-based fatigue as a means of selecting lead-free solder alloys, Eckermann J, **Mehmood S**, Davies H M, Lavery N P, Brown S G R, Sienz J, Jones A, Sommerfeld P, EuroSime, 2013 at Wroclaw, Poland
- Madsen B, **Mehmood S** and Aslan M, Variability in properties of natural fibers, NATEX Workshop, 18th April, 2012, Netcomposites Chesterfield UK
- **Mehmood S**, Recycling of post-consumer plastic wastes: An oral presentation at seminar arranged by Netcomposites Chesterfield UK, September 23, 2010