

Structuring and preparation of a lesson: EAE module 5 (The bonding process)

time	Theme, core information, statements or questions	Learning objectives ¹	Methods (e.g. presentation/ discussion/group work)	Media/ training material
1h	<u>Introduction to the Bonding Process</u> Overview over the necessary steps to achieve a bond Surface treatment Adhesive application Steps for achieving the adhesive strength Adhesive curing	Be able to interpret and explain the fundamental principles and concepts surface treatment (1). Be able to explain the fundamental principles to apply an adhesive(1) Be able to explain the fundamental steps to achieve adhesive strength(1) Be able to explain the fundamental principle of curing adhesives(1) To be able to know how to implement and apply a bonding process(2)	Presentation of necessary steps to apply a bonding process: Repetition of different surface preparations Presentation of an overview of application technologies Presentation of an overview of checklist for the bonding process	Slides presentation White board. Examples with videos .
1h	<u>Sourcing and Storing Adhesives:</u> Durability guarantee Predelivery check Safety data sheet Storing Adhesives	Be able to explain the criteria of sourcing adhesives and supplies on a particular bonding process(1). Be able to interpret the parameters of durability	Demonstration of parameters and criteria of sourcing and storing Discussion about	Slides presentation. Examples with videos White board.

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	<p>Temperature Time Moisture Light dispersion adhesive barrel forms</p>	<p>guarantees and safety datasheets(1).</p> <p>Be able to explain the main influence factors of storing adhesives and the necessary storing conditions(1).</p> <p>Be able to explain the advantages and disadvantages of different barrel and storage- forms(1).</p> <p>Be able to choose, order and control adhesives and supplies</p> <p>Be able to create storage environment that corresponds with the necessary requirements of a certain adhesive and supply</p>	<p>sourcing and storing problems within the companies of the participants</p> <p>Demonstration and Discussion about contents and parameters of durability guarantee and datasheets</p>	
7h	<p><u>Preparation and application of the Adhesives</u> Procedure and equipment for:</p> <ul style="list-style-type: none"> • Conditioning • Dosing & Mixing • Metering • Dispensing • Control 	<p>Be able to identify and explain the different procedures of conditioning like tempering, drying, stirring and cutting(1).</p> <p>Be able to identify and explain the different parameters, procedures</p>	<p>Demonstration of the procedures of preparation of adhesives</p> <p>Discussion about the (dis-) advantages and</p>	<p>Slides presentation.</p> <p>White board.</p> <p>Examples with videos</p>

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	<p>Methods of Adhesive Application</p> <ul style="list-style-type: none"> • Brushing • Flowing • Spraying • Roll coating • Knife coating • Silk screening • Melting <p>Other</p>	<p>and equipment of dosing and mixing (volumetric dosing, time pressure dosing, manual dosing, pneumatic dosing) (1).</p> <p>Be able to identify and explain the different metering valves, their application and (dis-) advantages(1).</p> <p>Be able to identify and explain the different dosing valves, their application and (dis-) advantages (1).</p> <p>Be able to identify and explain the different mixing technologies, their application and (dis-) advantages (2K mixing, hand mixing, tumbling mixing, statically mixing, static- dynamically mixing, dynamic mixing) (1).</p> <p>Be able to identify and explain the different dispensing equipment,</p>	<p>when which preparation methode has to be applied</p> <p>Demonstration of the equipment of preparation of adhesives</p> <p>Discussion about the (dis-) advantages and when which equipment of preparation of adhesives</p> <p>Demonstration of application methods and their parameters</p>	
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		<p>their application and (dis-) advantages (Transfer pumps, drum pumps, bung-mounted pumps, submersible pumps, piston pumps, membrane dispensing valves, needle dispensing valves, high-speed valves, spray valves) (1).</p> <p>Be able to identify and explain the different controll equipment, their application and (dis-) advantages (flow Controllers, needle stroke detection systems, flow meters, cameras, thermographie) (1).</p> <p>Be able to identify and explain the different methods of applying adhesives, their application and (dis-) advantages (brushing, blowing, spraying, roll coating, knife coating,</p>		
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		<p>silk screening, melting, others) (1).</p> <p>Be able to layout an adhesive application process</p> <p>Be able to evaluate different methods of applying adhesives (3)</p> <p>Be able to choose and evaluate various control devices and dispensing equipment (3)</p> <p>Be able to take decisions on application methods (3)</p> <p>Be able to take decisions on dispensing equipment (3)</p>		
5h	<p><u>Assembly</u> Order of Assembly</p> <p>Ease of assembly</p> <p>Methods of Adhesive Bonding</p> <ul style="list-style-type: none"> Wet bonding 	<p>Be able to identify and explain the correct geometrical assembly of specific bonds(1).</p> <p>Be able to identify and explain the optimal clamping strategies for specific bonds(1).</p> <p>Be able to explain the different methods of</p>	<p>Demonstration of various ways of assembly order</p> <p>Discussion about the (dis-) advantages and differences of assembly order</p> <p>Demonstrations</p>	<p>Slides presentation.</p> <p>Demonstration objects (e.g. different types of hybrid joints).</p> <p>Examples with videos</p>

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	<ul style="list-style-type: none"> • Reactivation bonding • Pressure sensitive bonding • Other methods of bonding <p>Environmental Aspects</p>	<p>adhesive bonding (wet bonding, reactivation bonding, pressure sensitive bonding, others). (1).</p> <p>Be able to explain the different influences on adhesive bonding in regards of the environment (thermal effects, moisture effects). (1).</p> <p>Be able to describe the correct practical considerations that are related to manufacture process of an adhesively bonded structure. (1).</p> <p>Be able to clarify how the joint design must enable a simple assembly process(1).</p> <p>Be able to identify and choose the correct way of tooling a bond. (1).</p> <p>Be able to distinguish and setup the correct geometrical assembly of</p>	<p>how the ease of assemblies can be reached</p> <p>Presentation of bonding methods and their parameters</p> <p>Discussion about differences of bonding methods and advantages</p> <p>Demonstration of environmental effects and discussion on how to prevent the effects</p>	
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	<ul style="list-style-type: none"> • Thermal effects • Moisture effects 	<p>specific bonds (2)</p> <p>Be able to distinguish the correct and easiest clamping method on a bond. (3)</p> <p>Be able to prevent the bond from negative influences. (2)</p>		
0,5h	<p><u>Bonding Pressure</u> Bonding Pressure Equipment:</p> <ul style="list-style-type: none"> • Hydraulic presses • Hydraulic pads • Weight loading • Clamps • Vacuum bag application <p>Autoclave vessels</p>	<p>Be able to explain the different methods of applying pressure on a bond(1).</p> <p>Be able to identify which adhesives need pressure at the curing process(1).</p> <p>Be able to determine pressure values and pressure equipment for specific bonds (2)</p>	<p>Demonstration of bonding pressure equipment</p> <p>Practical demonstration of available pressure equipment</p>	<p>Slides presentation.</p> <p>Demonstration objects (e.g. different types of hybrid joints).</p>
4h	<p><u>Adhesive Curing</u> Room temperature Direct heat curing</p> <p>Radiation curing</p> <ul style="list-style-type: none"> • UV curing • Visible light curing • Infrared curing 	<p>Be able to explain the different mechanisms of curing(1).</p> <p>Be able to explain the different parameters of different curing processes(1).</p> <p>Be able to explain the processes with which</p>	<p>Demonstration of curing procedures</p> <p>Practical demonstration of results of different curing processes</p> <p>Discussion about differences of the</p>	<p>Slides presentation.</p> <p>Demonstration objects (e.g. different types of cured bonds).</p> <p>Examples with videos</p>

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	<p>Microwave curing Moisture curing Electric heaters High frequency dielectric heating Induction heating Low-voltage electric heating Ultrasonic activation</p>	<p>curing can be induced(1). Be able to indentify which bonding process is connected to a specific curing process(1). Be able to determine a curing method for a specific process (3) Be able to evaluate risks and imperfection possibilities caused by an specific curing process (3)</p>	<p>bonds</p>	
4h	<p><u>Inspektion</u> Process control and quality assurance Evaluation of fabricated parts Standards</p>	<p>To be able to identify which parameters can be observed and explain how deviations of the specified values will influence the process (pneumatic pressure monitoring, level monitoring, bubble detection, input pressure monitoring, drive, monitoring, optical sensors and cameras, thermographs) (1). To be able to explain how parameters can be observed and controlled</p>	<p>Demonstration of process- control equipment Practical demonstration of results of process-control (measurement data, camera- , thermography pictures, ...) Demonstration of evaluation criteria Demonstration of</p>	<p>Slides presentation. Demonstration objects Discussion of various measured data in combination with bonding results.</p>

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		<p>(pressure sensors, reed contacts, capacitive sensors, ultrasonic sensors, paddlewheels, inspection of adhesives lines and mixing quotients by cameras) (1).</p> <p>To be able to explain which control mechanisms make sense in regards to quality management and process stability and cost effectiveness (1).</p> <p>To know which standards have to be applied on a specific bonding process and how and be able to interpret them (1).</p> <p>Be able to choose the best way of controlling an adhesive application. (3)</p> <p>Be able to choose the right quality assurance including evaluation and standards (3)</p>	standards	
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5h	<p><u>Automation and Robotics</u> Automation Principles of automated systems:</p> <ul style="list-style-type: none"> • Kinematics • Drives • Sensors • Controllers and systems • Coordinate systems and programming <p>Applications</p>	<p>Be able to explain the various kinematics of automated systems and their (dis-)advantages(1).</p> <p>Be able to explain (dis-)advantages of different drives(1).</p> <p>Be able to explain (dis-)advantages of controller-features(1).</p> <p>Be able to explain the most common application failures caused by automated systems(1).</p> <p>Be able to name application examples and their (dis-)advantages(1).</p> <p>Be able to explain the fundamental principles and concepts for designing joint for automated manufacturing. (1).</p> <p>Be able to evaluate characteristic of automated system for decision finding (3).</p>	<p>Demonstration of principles of automated systems</p> <p>Practical demonstration of programming a automated system</p> <p>Practical demonstration of designing a suitable joint for automation</p> <p>Discussion of other ways to design this joint</p>	<p>Slides presentation.</p> <p>Offline Robot Programming Software</p> <p>Videos</p> <p>CAD Programms</p>
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		<p>Be able to solve production instabilities caused by automation of the process(3)</p> <p>Be able to design joints suitable for implementation in automated manufacturing procedures. (2)</p>		
4h	<p><u>Factory Layout</u> Production layout Process planning Production flow Value analysis Costing and economics</p>	<p>Be able to explain the fundamental principles and concepts for designing a factory layout in regards of effectiveness, safety and production stability. (1).</p> <p>Be able to explain the fundamental principles and concepts for process planning and production flow(1).</p> <p>Be able to list the costs associated with bonded joints and to summarize the methods that allow the reduction of these production costs. (1).</p>	<p>Practical demonstration of different production layouts</p> <p>Demonstration of process planning and production flow systematics</p> <p>Perform a value and cost analyses</p>	<p>Slides presentation.</p> <p>Calculation sheets and software</p> <p>Videos</p> <p>CAM Programms</p>

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		<p>Be able to create a sketch of a production layout. (2)</p> <p>Be able to create a production workflow diagram(2)</p> <p>Be able to make a cost analysis(3)</p> <p>Be able to effectively use the advantages of adhesive joints to improve processes and products. (3).</p>		
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