

Processed Text

use composite aerospace past present future challenge dr faye smith ceng fimmcontents introduction composite use composite aerospace current challenge opportunity future challenge opportunity summary 2 2013 avalon consultancy service ltdintroduction composite introduction composite 3 2013 avalon consultancy service ltdmaterial evolution evolution driven economics logistics expectation society evolution facilitated development material processing method design tool understanding material 4 2013 avalon consultancy service ltdmaterial evolution stone age bronze age material age iron age steel age man plastic age silicon age designer material age 5 2013 avalon consultancy service ltdwhat composite composite material one composed least two element working together produce material property different property element typically reinforcing fibre matrix ultimate designer material 6 2013 avalon consultancy service ltda wealth design option 7 2013 avalon consultancy service ltdcomposite property given stiffness composite low composite excellent specific density strength stiffness swot analysis strength opportunity property innovative manufacturing high strength weight ratio automation alm ooa fatigue resistance corrosion resistant reduced life new recycling technology cost legislation tailor property within part smart functional material self complex shape possible healing heating morphing lower pressure tooling shm reduced part fastener count reduced material waste weakness threat high cost titanium ffc process damage tolerance innovation metal machining alm ndt requirement super plastic forming lack design data tool recycling issue improving high profile failure uncertainty failure prediction material shortage improving legislation reach need specialised repair cost oil technique 9 2013 avalon consultancy service ltduse composite aerospace application use composite aerospace application 10 2013 avalon consultancy service ltdaircraft composite content graph show civil aircraft black military purple historically military used h g composite civil ie w since 2005 civil aircraft b e dramatically increased composite content p airbus relatively steadily c increased usage composite year h boeing jumped 12 f r c composite weight 777 r ia f 50 composite weight 787 next generation single aisle percentage composite launch date still unknown 11 2013 avalon consultancy service ltddevolution composite application airbus main wing center wing box fuselage flap wing rib rear bulkhead a350 dry htp box rear unpress keel beam lg door fuselage j nose engine cross beam a380 cowling elevator vtp box wet htp box rudder aileron a340 600 fairings spoiler a320 a330 a340 radome airbrake upper wing a310 a400m a300 1970 1980 1980 1990 1990 2000 2000 2013 a330 300 a340 600 500 a310 300 a320 200 a380 a350 a300 b2 a310 200 a340 300 a400m 12 2013 avalon consultancy service ltdaircraft composite content 13 2013 avalon consultancy service ltdexplanation development composite aerospace use costly potentially risky therefore initial development performed military relatively large development budget risk averse civil side civil side composite development restricted non structural application however driver produce light weight structure provided price oil change attitude towards environmental issue e g acare target 50 reduction c0 2 50 reduction perceived noise 80 reduction 2020 x predicted increase airline traffic 14 2013 avalon consultancy service ltdexplanation composite give oems opportunity produce lightweight structure thereby reducing fuel bill reducing emission cost development introduction new structure offset gain hence increase usage composite aerostructures 15 2013 avalon consultancy service ltdcurrent challenge opportunity 1 manufacturing 2 mro 3 functional composite 4 reputational damage 16 2013 avalon consultancy service ltd1 manufacturing prepreg autoclave cure traditionally standard aerospace necessary guarantee ultimate quality high v f appropriate large scale structure preparation cycle time long lay process autoclave cure process 17 2013 avalon consultancy service ltdmanufacturing build rate rising satisfy demand oems needed find way without compromising quality increase production rate eliminate autoclave produced two trend automated production e g automated tape laying atl automated fibre placement afp autoclave processing e g infusion scrimp rfi rtm afp atl afp automated fibre placement atl automated tape laying provide rapid automated placement strip prepreg material onto mould afp used much complex geometry lay narrow tow steered sharply curved surface whereas wider tape placed without buckling fibre potentially weakening laminate cure either done autoclave long appropriate material used example usage 787 nose a350 fuselage panel autoclave processing process involves laying dry fabric introduction resin either wet film form using vacuum pull fabric many variation

technique therefore wealth name acronym vacuum infusion resin film infusion rfi vacuum assisted resin transfer moulding vartm scrim etc technique allows use technical textile provides design freedom enhanced thickness property however resin usually relatively low viscosity allow flow fabric mean compromising toughness final part example a380 rear bulkhead a400m cargo door textile 21 2013 avalon consultancy service ltd2 mro maintenance maintenance repair overhaul mro requirement composite different metal shorter track record use metallic structure many mro company therefore much experience maintaining composite structure part designed cope typical defect damage although given variation microstructure composite even difficult non destructive testing required pick damage growth beyond limit specific challenge maintenance specific defect type due inhomogeneous nature composite defect initiated manufacturing well service inspection regime usually involves use several ndt technique new development existing technique offer improvement current state art need validated certified 22 2013 avalon consultancy service ltdmanufacturing defect type fibre misalignment inappropriate fibre volume fraction overlap gap fibre bundle knot missing roving inclusion contamination uneven insufficient curing non uniform hardener content cure shrinkage delamination broken buckled fibre matrix cracking excessive porosity void poor wet dry spot 23 2013 avalon consultancy service ltdin service defect type impact damage ballistic damage moisture ingress chemical attack uv damage weathering erosion abrasion fatigue 24 2013 avalon consultancy service ltdndt method visual ultrasonics radiography thermography laser shearography coin tap testing microwave acoustic 25 2013 avalon consultancy service ltdmro repair damage composite repair damage composite involves cutting fibre therefore strength stiffness repaired composite always compromised repair composite usually us one 2 technique bolting patch potentially metal damaged area scarf repair bolted patch increase weight scarf repair technique require clean condition time consuming traditionally utilised expensive difficult store prepregs field repair technique based dry fabric preforms infusion investigated possible problem centre around use brittle resin infusion likelihood poor fatigue life shock resistance 26 2013 avalon consultancy service ltd3 functional composite virtue fact composite material consist one material material formed time part possible incorporate material structure processing provide integrated functionality part following slide provide example research done provide additional functionality composite structure area self healing sensing morphing lightning protection energy storage 27 2013 avalon consultancy service ltdself healing composite example hollow fibre bond et al bristol university lost wax process r trask et al bristol university sheffield solid state healing courtesy bristol university hayes et al sheffield university courtesy sheffield university 28 2013 avalon consultancy service ltdsensing order trigger self healing composite need able detect damage e contain health monitoring system many approach development including fibre optic bragg grating e g aston uni birmingham uni insensys ulster woven structure carbon nanotube graphene reading uni imperial bristol uni cambridge uni etc ferromagnetic microwires bristol uni acoustic emission airbus 29 2013 avalon consultancy service ltdmorphing structure change shape negate need motor weight adding mechanism example bristol university tow steered composite variable stiffness form bi stable structure panesar p weaver morphing corrugated structure c thill et al prestressed bistable composite daynes weaver p potter k hardick u k patent application 30 2013 avalon consultancy service ltdlightning protection two type effect caused lightning strike physical damage attachment location indirect effect induced voltage current prevention method composite structure cu foil mesh outer ply co bonding cu strip inside skin panel insulation cap collar nut fastener conductive paint sprayed metal al foil strip shielding nickel coated carbon fibre example new innovation mast consortium uk mod programme developed integral woven sma carbon fibre preform improved damage tolerance lightning protection bristol rus et al cnt coating lightning protection 31 2013 avalon consultancy service ltdenergy storage giving composite structure added functionality able store energy could allow reduction weight elimination heavy battery work imperial college produced composite supercapacitor prototype developed aircraft tertiary structure automotive application courtesy imperial college 32 2013 avalon consultancy service ltd4 reputational damage dangerous time reputation composite structure increase use aerostructures widely reported closely monitored press airbus a300 crash queen nov 2001 team phillips catamaran classic example confidence composite damaged despite neither failure due deficiency composite material delay production 787 primarily due lesson learnt boeing outsourcing part production could associated problem composite part production shame press congratulating aerospace industry innovation

development use new material fact sector strict regulation procedure facilitated safe implementation new structure industry sector learn 33 2013 avalon consultancy service ltdfuture challenge opportunity carbon fibre availability 1 recycling 2 material development 3 34 2013 avalon consultancy service ltd1 carbon fibre availability global usage carbon fibre growing many industry sector growth rate accelerating 35 2013 avalon consultancy service ltdcarbon fibre availability carbon fibre production globally aircraft approx flyaway total flyaway 2012 45 000 tonne predicted weight weight build rate per cfc per c aerospace sector year sector increasing use carbon fibre massive boeing 777 80 10 tonne 800 expansion wind boeing 787 112 35 tonne 3920 automotive sector although current producer airbus a380 45 35 tonne 1575 increasing production new airbus a350 116 61 5 7377 producer coming online high rate aerospace grade fibre approx predicted annual demand 4 13672 tonne expensive produce aircraft need certified use therefore increase production may fly buy rate 55 limited 60 carbon fibre demand 4 shortage supply suitable plane alone could 23 000 fibre drive price make 24 000 tonne annually metal seem like viable option future design 36 2013 avalon consultancy service ltd2 recycling 3000 tonne cfrp scrap produced annually 6000 8000 commercial plane expected reach end life dismantlement 2030 neither landfill incineration disposal cfrp scrap optimal environmental regulation may eventually lead ban therefore work done develop method used recycle carbon fibre cfrp process recently commercialised recycled carbon fibre uk cfrk work need done valley stade recycling gmbh demonstrate property germany recyclate create market give currently real market value recycled product produced 37 2013 avalon consultancy service ltd3 material development recent increase use composite involved development new improved manufacturing method manufacturing technique allowing u develop part testing limitation material used future application require development material property example boeing 787 cfrp fuselage boeing wanted scale produce new 737 composite fuselage hail stone could potentially penetrate fuselage one possible solution rather increasing thickness fuselage increasing weight plane look use tougher composite material 38 2013 avalon consultancy service ltdsummary 39 2013 avalon consultancy service ltdsummary environmental regulation meant cost introduction lightweight composite structure often offset gain led significant increase use aerospace composite structure current challenge include development rapid rate manufacturing process coping mro requirement different metallic structure avoiding reputational damage composite high profile current opportunity include ability composite structure include functionality morphing energy storage damage sensing self repair etc future challenge include supply carbon fibre may struggle match increase demand developing application recycled carbon fibre developing new material optimise output new production method 40 2013 avalon consultancy service ltdwww avaloncs.com 41 2013 avalon consultancy service ltd

Top Keywords

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