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AN OVERVIEW ON EMBEDED COMPOSITES WITH STEEL WIRE

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ABSTRACT- This paper review on impact study of steel wire composites. Composites are one of the most widely used materials because of their adaptability to different situations and the relative case of combination with other materials to serve specific purposes and exhibit desirable properties. The impact test is a method for evaluating the toughness and notch sensitivity of engineering materials. This paper presents some basic research results for the application of the steel wire embedded composites structural systems. The research and development in steel wire composites are highly highlighted in this article.

Keywords: Toughness, Impact study, steel wire.

I. INTRODUCTION

These reviews have been carried out as part of a investigating the application of impact study embedded with steel wire composites. The purpose of composites is to allow the new material to have strengths from both materials, Composite materials integrated into aerospace, automotive, trucking, and mass transit will all have fuel saving benefits. Additionally, products manufactured with composites will require less energy to transport or ship then traditional materials. Glass fiber reinforced plastics (GFRP) are increasingly being used for varieties of engineering applications because of their superior advantage over other engineering materials. The advantages include high strength to weight ratio, high fracture toughness and excellent corrosion and thermal resistance. The stainless steel gives engineers extra flexibility in their design due to its excellent corrosion resistance, weight to strength and fabrication properties.

II. COMPOSITE WITH STEEL WIRE ANALYSIS

Entangled steel wire (Q195F) with total porosity of 36.3±1.3 to 61.8±2.4% and pore sizes of 15–825 μm have been investigated in terms of the porous morphologies, impact deformation and failure behavior. The results reveal that the impact toughness increases with the decrease of the porosity [1]. To emphasize the role of anisotropy in a bulk forming process, namely pearlitic steel flat wire cold rolling. The measured geometry of flat-rolled wires has been compared to computations, with both isotropic and anisotropic plasticity [2]. Investigate the bond behavior between GFRP/steel wire composite rebars and concrete. According to American Concrete Institute (ACI) code, a total of 180 pull-out specimens were tested under monotonic static loading conditions. The test parameters were the rebar rib spacing, rebar diameter, embedded length, concrete compressive strength, concrete cover thickness, and concrete cast depth. Based on the numerical analysis of the test results, new criteria for acceptable bond performance of GFRP/steel wire composite rebars to concrete were developed [3].

Analyse a Charpy V-notch impact test studies on AISI 4118 steel over a wide range of temperature demonstrated that both effective case depth and hydrogen charging reduced the impact energy. Carburization has raised the ductile-to-brittle transition temperature (DBTT) from - 60°C to 30 °C for uncharged specimens and from - 50°C to 32 °C for hydrogen-charged specimens. The carburization, which induced network cementite and pearlite in furnace-cooled specimens and high-carbon plate martensite in quenched and tempered specimens, resulted in low impact absorbed energy [4]. The influence of temperature on impact toughness and tensile properties of 8320 steel was investigated [5].

The effect of zirconium additions on the impact toughness of the heat affected zone in a high strength low alloy pipeline steel was studied, and the corresponding toughening mechanism examined when the welding was conducted with large heat input. The welding Of steels was simulated on a Gleeble 2000 [6]. The impact toughness of Mg–3Al–Zn alloy was systematically investigated with the focus on the effect of grain size. The impact toughness is greatly improved as the mean grain size is reduced to less than 3 lm, because the dynamic strength and dynamic plastic deformation ability are greatly enhanced [7]. The impact energy absorption characteristics of glass fiber-reinforced hybrid composites were investigated by the instrumented Charpy impact test method with respect to the volume fraction of deferent materials embedded [8].

The composite beams with closer position of delamination to impacted surface are able to absorb more energy in comparison with other delamination positions in hybrid and non-hybrid ones. The Charpy impact test of delaminated composite beams was also simulated by finite element software LS-DYNA and the results were verified with the relevant experimental results [9]. Analyse a fracture resistance, here viz the notched Charpy impact energy, of single SGF/PP and single SCF/PP and hybrid SGF/SCF/PP composites has been studied. The results show that the addition of short glass fibers and short carbon fibers to PP considerably enhances the notched Charpy impact energy [10].

Studies on stresses and damage in fiber reinforced polymeric matrix composite laminates subjected to transverse impact are conducted by a 3D finite element analysis. The stress analysis is carried out by developing a constitutive equation including damage variables, therefore, effects of damage and damage thresholds on the stresses in the laminates

can be investigated [11]. Optimization of hybrid fiber reinforced plastic laminated plates subjected to impact loading. Finite element method (FEM) and genetic algorithm (GA) have been used to obtain optimum laminate in terms of minimizing the cost, Weight or both cost and weight of graphite/epoxy (T300/5208)–aramid/epoxy (Kevlar 49) hybrid laminates while maximizing the strength [12]. Studies on damage in composite laminates subjected to central and normal impacts are conducted by a 3-D finite element analysis. The stress analysis is carried out by developing a constitutive equation of composite laminates coupled with the damage. Effects of the damage on the stress distribution in the laminates are investigated in details [13]. The design of advanced composite ructures or components subjected to dynamic loadings requires a deep understanding of the damage and degradation mechanisms occurring within the composite material. The present paper deals with the numerical simulation of low-velocity impact tests on glass fabric/epoxy laminates through the LS-DYNA Finite Element (FE) code [14]. Analyzed by the finite element method (FEM) transient elasto-plastic deformations of a fiber reinforced AS4/PEEK laminate impacted at normal incidence by a rigid sphere moving at a slow speed. The matrix is assumed to deform elasto-plastically and fibers elastically [15].

III. A REVIEW ON LOW VELOCITY IMPACT TEST

Analyze a low-velocity impact characteristics and residual tensile strength of carbon fiber composite laminates are investigated by experimentally and numerically. Low-velocity impact tests and residual tensile strength tests are performed using an instrumented drop-weight machine (Instron 9250HV) and static test machine (Instron 5569), respectively [16]. **T**he behavior of a composite laminate based on a micro-macro probabilistic approach. The material investigated is a T300/914 carbon- fiber epoxy-resin composite laminate [17]. Analytic method for the prediction of the compressive strength of composite laminates containing impact damage has been developed. Using the characteristics of the impact damage detected by the ultrasonic time-of-flight C-scan technique, the state of the damage is modeled by an elliptical soft inclusion [18]. Random variable based micro and macro-scale reliability analyses are critically compared through a limit state formulation based on the analytical stress tensor components of a rectangular simply supported orthotropic FRP composite plate and the Tsai–Hill failure criterion. The study aims to promote cross-fertilisation of alternative uncertainty modeling approaches in a multi-scale analysis framework. Propagation of uncertainty from micro to macro-scale, and the corresponding influence of changes in random variability on the reliability estimates is quantified [19]. The properties of carbon nanotubes and describes the preparation and properties of carbon nanotube composites. The prospects for commercial exploitation of these materials are discussed [20].

Reviewed the state of the art of shape memory alloy hybrid composites (SMAHC) for the purpose of damage suppression. First the general properties of SMAs and SMAHCs were considered, with particular emphasis on the fracture toughening mechanism [21].

low velocity impact tests have been carried out on a (0, 90) glass fiber reinforced epoxy resin in order to investigate the influence of varying key impact parameters on the damage initiation threshold.Initial tests have confirmed observations made by previous researchers, that is that the impact force required to initiate damage, Pcrit, varies linearly with t3/2, where t is the target thickness. This relationship has been shown to apply for test temperatures between 23 and 90 C [22].

Curved laminates are used in structures where impact is likely. Furthermore, due to the mechanisms of strength reduction, it may be expected that curvature would have a significant effect on the behavior of the laminates [23].

The impact response using the various impactor shapes. The only notable affect was on the specimens impacted by the conical impactor at initial impact energy of 4 J. When preload was introduced, a significant drop in load was observed in the force–time history which was attributed to the increase in indentation depth caused by the application of preload. However, although a significantly larger indentation depth was observed, the damage areas were found to be similar [24].

The Mixed Mode fracture characterization of an elastomer methacrilate (Loctite Multibond 330s) adhesive was performed using a bonded CTS specimen. Loading conditions ranging from pure Mode I to pure Mode II were considered. The comparison of the experimental results with the predictions of failure criteria from the literature showed that the best approximation is given by the criterion of which is equivalent to saying that the critical strain energy release rate is independent of mode mixity[25].

Analyse the relationship between the delamination resistance of GFRP and its impact resistance. The results show a consistent trend between the mode I delamination resistance and the critical force for the incipient impact damage. Difference of the impact resistance between the two GFRP, however, is mainly on the impact damage size developed. The total energy absorbed during the impact remains the same [26].

To establish a correlation between the damage occurring in a composite as a consequence of low-velocity impact and the energy dissipated during the impact phenomenon. To this aim, instrumented impact tests were carried out on glass fabric/epoxy laminates of three different thicknesses, using different energy levels. The irreversibly absorbed energy was obtained from the force–displacement curves provided by the impact machine. To assess damage progression as a function of impact energy, ply-by-ply delamination and fibre breakages revealed by destructive tests were measured [27].

IV. EFFECT OF FAILURE ANALAYSIS

Four types of fiber reinforced plates were tested, subjected to drop weight impact of a 19 mm diameter hardened metal sphere. The plates were clamped on a support and the impactor collided onto the centers of the plates. The impact energy ranged from 30 up to 100 J. For impact energy of 50 J two different masses of 2.5 and 5.5 kg were applied separately to observe the linear momentum effect. The damage area was reported by NDI and by visual inspection [29].

Epoxy/HBP blends were evaluated both as castings and as FRP composites. The epoxy resin matrices of FRP composites exhibit lower Tg compared to the corresponding castings. The epoxy/HBP blends show a two-phase morphology both in castings and in FRP composites. The microstructure was found to be different in FRP composites compared to that observed in castings. In FRP composites the morphological features are similar in the FRP composites, irrespective of the nature of fibers [29].

woven vinyl-ester composite plates up to 1.37 m long are numerically modeled with a simple, gradually damaging three-dimensional material model and the results are compared with full-scale tests. The model is based on damage mechanics principles using cyclic test data to obtain modulus reduction with damage. Delamination is modeled with a mixed-mode tractionseparation law using cohesive elements. The laminates were fabricated from 48 layers of cross-ply carbon fibre and glass fiber epoxy.Dynamic test results were compared with static compression test carried out on specimens with the same dimensions. Preliminary compressive stress–strain vs. strain rates data obtained show that the dynamic material strength for GFRP increases with increasing strain rates. The strain to failure for both CFRP and GFRP is seen to decrease with increasing strain rate[30].

Compressive test results for CFRP and GFRP indicate that both composite systems are strain rate sensitive in terms of the strain to failure experienced. However, results show that the ratio of strain to failure of the CFRP system at low strain rate to high strain rate is larger than that experienced by the GFRP. With respect to the ultimate stress at high strain rates GFRP appears more strain rate sensitive. This brings about the comparison of energy absorption, therefore the combination of strain to failure and ultimate stress The energy absorbed by the GFRP system is higher despite the reduced strain to failure as compared to the CFRP system. This observation is elucidated by considering the varying failure modes of the two composite systems at varying loading rates, fiber kinking which is prominent in GFRP coupled with the micro-buckling and fiber fracture at low strain rates and combination of global delamination,interfacial separation and spalling at high strain rates,resulting in low strain to failure and high ultimate stress.In the case of CFRP at low strain rate to high strain rate the failure mode changes from kinking and shear failure to complete disintegration of the specimen, respectively[31].

The effect of fiber orientation and different stacking sequences on mixed mode delamination failure in UD and MD laminates following experimental and numerical approaches. The load–displacement response of MD composites subjected to MMB is strongly dependent on the stacking sequence of the laminate[32].

V. CONCLUSION

The review has been performed on composites laminates at various fiber orientations, due to their applications of aerospace industry. Impacts on composites are less well documented, and progress is required in these areas if composite laminates are to be employed in more structural applications.

REFERENCES

[1] P. Liu, G. He, L.H. Wu1, 2009 Impact behavior of entangled steel wire material

[2] T. Masséa, Y. Chastela, P. Montmitonneta, C. Bobadillab, N. Persemb, S. Foisseyc. 2010 ,Impact of mechanical anisotropy on the geometry of flat-rolled fully pearlitic steel wires

[3] Qingduo Haoa, Yanlei Wangb, Jinping Oua, b, 2007. Design recommendations for bond between GFRP/steel wire composite rebars and concrete

[4] Chih Fu Yang a, Liu Ho Chiu a, Jiann Kuo Wu b1995 Effects of carburization and hydrogenation on the impact toughness of AISI 4118 steel

[5] C.C. Menzemer a, T.S. Srivatsan b, M. Al-Hajri b, R. Ortiz a,2002, The impact toughness and tensile properties of 8320 steel

[6] A.M. Guo, S.R. Lia, J. Guoa, P.H. Lib, Q.F. Dingb, K.M. Wuc,X.L. Hea, 2006,Effect of zirconium addition on the impact toughness of the heat affected zone in a high strength low alloy pipeline steel

[7] Jinsun Liao, Makoto Hotta, Kantaro Kanekoa and Katsuyoshi Kondohb,,2009 Enhanced impact toughness of magnesium alloy by grain refinement

[8] Seong Sik Cheon, Tae Seong Lim, Dai Gil Lee,1999 Impact energy absorption characteristics of glass fiber hybrid composites

[9] H. Ghasemnejad, A.S.M. Furquan, P.J. Mason,2010 Charpy impact damage behavior of single and multi-delaminated hybrid composite beam structures

[10] S.Y. Fua, B. Laukeb, E. MaÈderb, X. Hua, C.Y. Yuea,1999, Fracture resistance of short-glass-®ber-reinforced and short-carbon-®ber-reinforced polypropylene under Charpy impact load and its dependence on processing

[11] Dazhi Jiang, Dongwei Shu,2004 Effects of damage thresholds on stresses in composite laminates under transverse impact

[12] Rahul a, G. Sandeep a, D. Chakraborty a, A. Dutta,2006, Multi-objective optimization of hybrid laminates subjected to transverse impact .

[13] Dazhi Jiang, Dongwei Shu, 2003,Stress distribution in damaged composite laminates under transverse impact

[14] Costantino Menna a, Domenico Asprone a, Giancarlo Caprino b, Valentina Lopresto b, Andrea Prota a, 2011. Numerical simulation of impact tests on GFRP composite laminates

[15] R.C. Batra a, G. Gopinath a, J.Q. Zheng b, 2011. Damage and failure in low energy impact of fiber-reinforced polymeric composite laminates

[16] Shi-Xun Wang, Lin-Zhi Wu, Li Ma, 2009. Low-velocity impact and residual tensile strength analysis to carbon fiber composite laminates

[17] Bkachl& Lebon,a Constantin Baxevanakis,a Dominique Jeulinb & Jacques Renarda,1996. FRACTURE STATISTICS OF A COMPOSITE LAMINATE

[18] Y. Xiong & C. Poon, P. V. Straznicky & H. Vietinghoff, 1995, A prediction method for the compressive Strength of impact damaged composite laminates

[19] Andrew Shaw a, Srinivas Sriramula b, Peter D. Gosling a, Marios K. Chryssanthopoulos c,2010. A critical reliability evaluation of fibre reinforced composite materials based on probabilistic micro and macro-mechanical analysis

[20] P. J. F. Harris, 2011, Carbon nanotube composites

[21] S L Angioni1, MMeo1,3 and A Foreman2, Impact damage resistance and damage suppression properties of shape memory alloys in hybrid composites—a review

[22] F.J. Yang, W.J. Cantwell,2009 Impact damage initiation in composite materials
[23] G.J. Short, F.J. Guild, M.J. Pavier,2002 Post-impact compressive strength of curved GFRP laminates
[24] T. Mitrevski a, I.H. Marshall a, R.S. Thomson b, R. Jones a 2006, Low-velocity impacts on preloaded GFRP specimens with various impactor shapes
[25] A. Pirond, G. Nicoletto,2001, Mixed Mode I/II fracture toughness of bonded joints
[26] T. Kuboki*, P.-Y.B. Jar, T.W.2002, Forest Influence of interlaminar fracture toughness on impact resistance of glass fiber reinforced polymers
[27] G. Caprino, V. Lopresto, A. Langella, M. Durante,2011, Irreversibly absorbed energy and damage in GFRP laminates impacted at low velocity
[28] Ramin Hosseinzadeh a, Mahmood Mehrdad Shokrieh b, Larry Lessard,2006, Damage behavior of fiber reinforced composite plates subjected to drop weight impacts
[29] Debdatta Ratna,2008, Toughened FRP composites reinforced with glass and carbon fiber
[30] H.E. Johnson a, L.A. Louca a, S. Mouring b, A.S. Fallah, 2009, Modeling impact damage in marine composite panels
[31] R.O. Ochola a, K. Marcus a, G.N. Nurick b, T. Franz, 2004, Mechanical behavior of glass and carbon fiber reinforced composites at varying strain rates
[32] P. Naghipour, M. Bartsch, L. Chernovaa, J. Haussmann, H. Voggenreiter,2010 Effect of fiber angle orientation and stacking sequence on mixed mode fracture Toughness of carbon fiber reinforced plastics: Numerical and experimental Investigations.