FATIGUE OF FILAMENTARY COMPOSITE MATERIALS/STP 636 pdf

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A current worldwide review on traditional indicators used in water quality assessment. 25 papers cover automated monitoring techniques, classifications of environmental enteric strains, r-factors and salmonellae, use of bacteria in evaluation of water quality and water.

The composition of claim 1 wherein said material comprises polymethylmethacrylate. The composition of claim 1 wherein said material comprises methylmethacrylate-styrene. The composition of claim 1 wherein said material comprises a radiopacifier. The composition of claim 1 wherein said compound is added in the form of particles. The composition of claim 5 wherein said particles have mean pore diameters of greater than about 10 microns. The composition of claim 1 wherein said compound is silanated. The composition of claim 1 wherein said compound is further manufactured from fibers selected from the group consisting of zirconium fibers, carbon fibers, metal fibers, and mixtures thereof. The composition of claim 1 wherein said fusion source comprises boron. A method for improving a bone or dental composition comprising: The method of claim 11 wherein said compound is added in the form of particles. The method of claim 11 wherein said compound has mean pore diameters of greater than about 10 microns. The method of claim 11 wherein said added compound is silanated. The method of claim 11 wherein said compound is further manufactured from fibers selected from the group of fibers consisting of zirconium fibers, carbon fibers, metal fibers, and mixtures thereof. The method of claim 11 wherein said fusion source comprises boron. A bone or dental composition treatment kit for bone or tooth repair or other treatment of a bone or tooth defect, said kit comprising: The treatment kit of claim 18 wherein said polymer comprises polymethylmethacrylate. The treatment kit of claim 18 wherein said acrylic monomers comprise methylmethacrylate-styrene-copolymer. The treatment kit of claim 18 further comprising a radiopacifier. The treatment kit of claim 18 wherein said compound is added in the form of particles. The treatment kit of claim 18 wherein said compound has mean pore diameters of greater than about 10 microns. The treatment kit of claim 18 wherein said compound is silanated. The treatment kit of claim 18 wherein said compound is further manufactured from fibers selected from the group of fibers consisting of zirconium fibers, carbon fibers, metal fibers, and mixtures thereof. The invention is further directed to bone cement and dental cement system kits for bone or teeth repair or other treatment of bone and teeth. Because of its physical properties, the bone cement shrinks onto the prosthesis resulting in a closed metal-to-cement contact. The bone cements commonly used are polymethylmethacrylate PMMA consisting of powdery bead polymers which are superficially dissolved by liquid monomers and embedded during the polymerization process. During mixing the polymer is immersed in the monomers. The PMMA beads are superficially dissolved and embedded in a composite manner. The long term success of a total joint prosthesis depends on the continued function and interaction of each of the components of the prosthetic system. In a cemented total hip prosthesis, for instance, stress transfer from the pelvis to the femur is a function of the materials between the two bones e. The weakest of the materials is the PMMA, with the lowest fracture toughness and ultimate strength. The common mode of failure of total joint prostheses is aseptic loosening. X-ray examinations of patients with loosened prostheses often reveal a radiolucent line in the bulk of the cement, indicating that the cement has fractured. Because the geometry of the prosthesis is complex, the state of stress is also highly complex, and the reasons for cement failure are not clear. The improvement of the fracture characteristics of the bone cement, however, is a problem that has received some attention in recent years. The composition of the PMMA used for total joint surgeries today is substantially the same as that used 20 years ago; very little has been done to improve the material itself. The acceptable success rate of cemented prostheses was achieved using existing cements, however, in a predominantly elderly patient population and with improved surgical handling techniques. Cement failures do occur, and generally lead to revision surgery. Furthermore, younger patients now receiving total joint replacements have a greater life expectancy than the design expectations of the total joint prosthesis, improvement of the bone cement, exclusively, may not solve every problem associated with total joint replacements. But, by making improvements in each component of a total joint prosthesis, including the cement, the success rate of

prostheses will improve, and mechanical failures can be virtually eliminated. Increasing the longevity of PMMA by improving the resistance to failure of the polymer has received some, albeit surprisingly little, attention in the bioengineering literature in the past ten years. One suggested method of improvement was to formulate a new bone cement, based on n-butyl methacrylate, rather than the methyl methacrylate monomer. It has been reported that the material showed a higher ductility, a higher apparent fracture toughness, and a greater fatigue life. However, the actual fracture toughness determined by separate impact tests showed no improvement of the new cement with respect to PMMA cements. An even more detrimental result was that the new polymer had only half the modulus and half the ultimate tensile strength of PMMA. Another method of attempting to improve PMMA was the addition of a reinforcing phase, generally short fibers or whiskers. Early work was done by Knoell, et al. They also reported a decrease in peak curing temperature of the reinforced PMMA. They found the reinforced cement viscous and difficult to mix, and they altered the ratio of powder polymer to liquid monomer to facilitate mixing of the reinforced cement. However, it was implied that the reinforced PMMA had poor intrusion characteristics due to increased viscosity, and poor fiber distribution. PMMA reinforced with 5. Very few investigations involved the use of metal fibers to reinforce PMMA. Taitsman and Saha, J. They embedded 1, 2, or 3 wires in their PMMA specimens. Fishbane and Pond, Clin. They determined that the addition of fibers up to 6. The compressive strength of PMMA is not a critical property for the longevity of the cement in vivo. These authors postulate that the reason for the decreased performance of the surgical PMMA was: The concept is again similar to the reinforcing bars embedded in concrete. The more recent work in reinforcing PMMA bone cement as reported in the literature, has involved either carbon, graphite, or aramid fibers. In other work with carbon fiber reinforced PMMA an order of magnitude decrease in crack propagation velocity was attributed to the carbon fiber reinforcement of both the regular and low viscosity cements. Saha and Pal, J. The reinforced PMMA showed an increase in the ultimate compressive strength of Two important consequences of the addition of fibers to PMMA were proposed: They recognized that uniform dispersion of fibers was not achieved. Saha and Pal studied a machine mixing technique for distributing the fibers. Their claim that machine mixed specimens were stronger than non-machine mixed specimens is misleading. They used a different shaped fiber for their machine mixed specimens. It is the superior shape of the fiber which is presumed to account for the increase in strength. Machine mixing was never shown to improve the properties of reinforced PMMA. Recent work by Pourdeyhimi, et al. They used aramid fibers from 0. For each type of fiber reinforced cement, the fracture toughness increased with increased fiber content. The aramid fiber specimens showed a greater increase than the carbon fiber specimens of the same weight percent, presumably because the energy dissipated in the micromechanisms of failure is greater for the aramid fibers than for the carbon fibers. They were not able to produce a uniform distribution of the fibers. Fletcher reports only an increase in the modulus of the bone cement, which may not be of primary concern to a reinforced bone cement, and indeed can be detrimental to the prosthesis system. There was a decrease in compressive strength, and more negatively, a decrease in flexural strength for the reported composite. The particle size of the powder is from 10 to micrometers. Fiber diameters are not disclosed. Improvements in impact strength, and compression strength were reported. However, a significant decrease in the bending strength and an increase in the modulus of elasticity were also reported. Further, there are no examples given as to the clinical usefulness of this cement. Bioactive glass degrades with time, and hence the integrity of the reinforced bone cement will also degrade with time. The controlled experimentation shows that there is no mechanical improvement due to the fiber reinforcing phase alone. Any improvement is due to the combination of bioactive glass and fiber in concert. Since the bioactive glass degrades with time, the properties of the reinforced cement proposed by Gross, et al. The invention is restricted to use in repairing bone defects, and not as a bone cement in the sense described for total joint arthroplasty Draenert, in U. The fibers, however, are made up of the same polymeric material as the bone cement. Draenert includes a graph of the performance of the new material versus existing cements. The inventor states that the fiber is only effective because of the shape of the prepolymer powder. Therefore, the improvement is due to the use of a different cement, and not to the addition of the fibers. It is generally agreed that as the quantity of reinforcing fibers increases so do the mechanical strength properties. However, as the

fiber content increases it becomes increasingly difficult and eventually not practical or possible to effect homogeneous distribution of the fibers throughout the cement mass and in addition the viscosity of the mass increases and its workability by the surgeon during surgery decreases. Any practically useful surgical bone cement must be capable of being easily mixed by the surgeon in a clinical setting, i. It is another object of the invention to provide a fused fibrous reinforced surgical bone dental cement wherein mixing of the fiber reinforcement into the cement matrix can be easily performed by the surgeon under clinical conditions. The above and other objects of the invention which will become more apparent after reading the following detailed description and preferred embodiments in conjunction with the accompanying drawings are accomplished, according to a first aspect of the invention, by an acrylic based surgical bone cement with fused fibrous compound added thereto. The kit includes a biocompatible polymer, generally in the form of powder or beads, a liquid reactive monomer, and a plurality of fused fibrous compound particles wherein the fibers in each particle are fused to each other at their points of contact with a fusion source, said fusion point not soluble in the liquid reactive monomer. According to further embodiment, the bone cement composition comprises barium sulfate. The preferred bone cement material to which the fused fibrous compound is added includes a solid finely divided powdery or granular polymer component and a liquid reactive or polymerizable monomer component which is also a solvent or swelling agent for the polymer component. The polymer and monomer components can be based on the acrylic, e.

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Fatigue fracture behavior of a hybrid joint part for the tilting car body was evaluated in comparison to the case of static fracture. The specimens of hybrid joint part applied in the real tilting car body were fabricated for the bending test. Characteristic fracture behaviors of hybrid joint part specimens under cyclic loads were obviously different from the case under static loads. Static bending load caused the shear deformation and fracture in the honeycomb core region, while cyclic bending load did the delamination along the interface between composite skin and honeycomb core layers as well as the fracture of welded joint part. Experimental results obtained by static and fatigue tests were reflected in modifications of design parameters of the hybrid joint structure in the real tilting car body. The fatigue properties of ferritic-pearlitic-bainitic steel using specimens produced from massive forging were measured in stress controlled regime with positive mean stress. The fatigue life was plotted in dependence on the mean stress and on the plastic strain amplitude. The principal contribution to the drop of the fatigue life with the mean stress is due to the increase of the plastic strain amplitude in cycling with mean stress. Many mechanical components are subjected to multiaxial fatigue. However the majority of experimental data available in the literature are focused on the simpler uni-axial fatigue problem. The present work describes a series of experimental tests conducted to characterise in a comprehensive way the multiaxial behaviour of a STN structural steel. First, the monotonic properties of the steel were obtained experimentally. Then cyclic properties were also measured both in the longitudinal and torsional axes. Finally another series of tests were carried out to study the multiaxial response of the material. Both in-phase proportional and out-of-phase non proportional loadings were employed, thus providing a complete database for improving current models which describe the multiaxial behaviour of materials. In order to identify the influence of solid solution, aging and solid solution plus aging treatments on the low-cycle fatigue behavior of the extruded AZ61 magnesium alloy, the low-cycle fatigue tests were performed at room temperature for the extruded AZ61 magnesium alloy with different treating states. The results indicate that the cyclic stress response behavior of the extruded AZ61 magnesium alloy exhibits both cyclic strain hardening and stability. The solid solution, aging and solid solution plus aging treatments tend to decrease the cyclic deformation resistance of the extruded AZ61 alloy in most conditions. The solid solution treatment can enhance the fatigue lives of the extruded AZ61 alloy at medium total strain amplitudes. In addition, the aging treatment can prolong the low-cycle fatigue lives of the AZ61 alloy at most total strain amplitudes, while the case for the solid solution plus aging treatment is just contrary. For the extruded AZ61 alloy with different treating states, a linear relationship between cyclic stress amplitude and plastic strain amplitude is noted. Disposable mechanical elements with extremely short lives are widely used in the aerospace and defense fields. To reliably evaluate the life of disposable mechanical elements, many attentions were concentrated in the fatigue properties of disposable mechanical elements. According to the different meanings of static strength for metals, disposable mechanical elements are divided into two groups with different fatigue properties: The Kuroda model and a cumulative damage model consisting of the Miners rule and the sequential law are used in the fatigue design process of the Type I. To the Type II, the Manson-Coffin model is suitable for conventional applications but more attempts are still conducted to further improve stress levels. The Type II with increasing load sequences are specially treated, since the cyclic yield strength of certain materials under pulsating stress closing to the yield strength increase with the deepening of fatigue damage. Consequently, under the increasing pulsating cyclic loading, the later load whose amplitude is higher than the initial yield strength will be permitted.

3: STP Fatigue of Filamentary Composite Materials

Foreword The symposium on Fatigue of Filamentary Composite Materials was preÂ- sented at a meeting held in

Denver, Colo., Nov. The symposium.

4: Probabilistic Simulation for Combined Cyclic Fatigue in Composites

Fatigue behavior of glass fiber reinforced epoxy composite materials has been studied analytically. A new concept called "fatigue modulus," which is defined as a slope of applied stress and resultant strain at a specific cycle is introduced. Fatigue modulus degradation is studied using an assumption.

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