Polyvinylidene floride(PVDF)를 이용한 케블라 섬유접착에 마이크로웨이브에 관한 연구

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Study on the microwave heating on kevlar fiber-bonding using Polyvinylidene floride(PVDF)

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Introduction

In conventional heating, the heat source causes the molecules to react from the surface toward the center so that successive layers of molecules heat in turn. In the microwave heating, which is produced a volume heating effect, all molecules are set in action at the same time. And, It also evens temperature gradients without the concern of material thickness. Thus, microwave heating important benefits such as selective heating. In this study, the possibility of Kevlar fiber-bonding using the PVDF which have high dielectric constant polymer, as bonding media has investigated and their morphological structure and bonding force have investigated with different treatment time.

Experimental

We used Kevlar 49 (2den.) of Dupont company in this study. Kevlar fiber has very low dielectric loss factor. So it is impossible to microwave heating. Thus, we used PVDF particles with having high permittivity, chamical stability and fire-resistance as bonding media. We laid out 500 Kevlar fibers between two glass plates like Figure 1. And on crossing point between two Kevlar fibers added 8mg of PVDF . And then it was treated by microwave system.

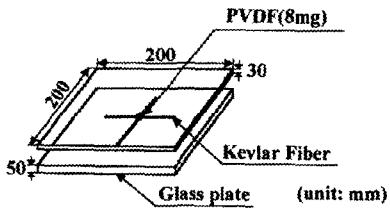

Figure 1. Schematic diagram of sample preparation.

Result & discussion

Morphological structure: Figure 2 shows morphological structure on

bonding region of Kevlar fiber by PVDF. As treatment time was increased, we could observe that PVDF was melted perfectly and Kevlar fiber was firmly united. But Kevlar fiber was not melted alone. Bonding of Kevlar fiber was not occured in treatment time for 400 second or less. This is due to be formed circular shape with minimum for surface tensile value of PVDF particles occured perfect melting, as increasing treatment time.

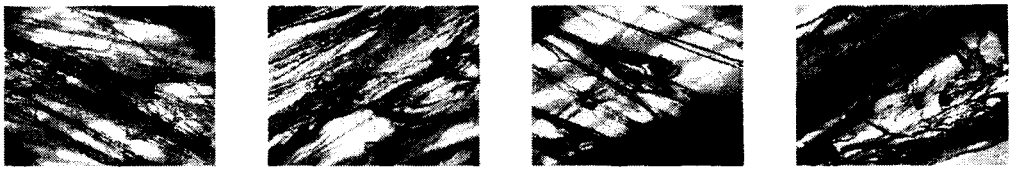

Figure 2. Photographs(×50) of Kevlar samples bonded by microwave heating with treatment time.(unit: second)

Debonding behavior: Figure 3 shows load-displacement curves of Kevlar fibers bonded using PVDF with microwave treatment time. As treatment time increased, load increased and displacement decreased. This showed that PVDF was completely melted above 480sec. Kevlar fiber was not break because of high-strength fiber and fracture started from bonding region.

Bonding force: Figure 4 shows bonding force of Kevlar sample bonded microwave as treatment time. As increasing treatment time, bonding force increased rapidly. As shown in Figure 3, this is due that PVDF used as bonding agent was melted with increasing treatment time, and it united Kevlar fiber. When treatment time was increased up to 510sec, bonding force showed the maximum value.

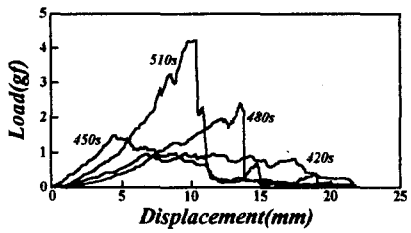

Figure 3. Load-displacement curves of bonded samples with treatment time.

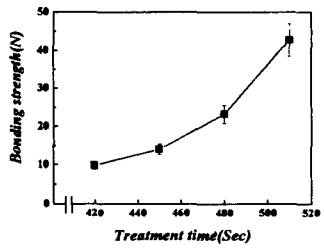

Figure 4. Effect of treatment on bonding force of Kevlar sample bonded by microwave heating.

Conclusion

As using the microwave heating, Kevlar fiber was not melted. But Kevlar fiber was bonded as doing microwave heating with PVDF particles used as bonding agent. As increasing treatment time, PVDF particles was melted entirely and it covered the surface of Kevlar fiber.