

**A review on mechanical properties of PVC in blend with CPE and UPS****Farshid Iranmanesh, Fariborz Iranmanesh, Behzad Mahjour Shafiei, Mohammad Amin Saeed***Kerman Branch, Islamic Azad University, Kerman, Iran*

Farshid Iranmanesh, Fariborz Iranmanesh, Behzad Mahjour Shafiei, Mohammad Amin Saeed: A review on mechanical properties of PVC in blend with CPE and UPS

**ABSTRACT**

In this article mechanical properties of PVC (polyvinyl chloride) in blend with CPE (chlorinated polyethylene) and UPS (ultrafine particles of polystyrene) was reviewed. The mechanical properties of PVC such as impact strength, breaking elongation, tensile strength was studied and the results show that combine of PVC and CPE can improve the properties of PVC but it has defects that we can promote them by adding UPS.

**Key words:** Properties of PVC, PVC blend, Impact strength of PVC, PVC blends.

**Introduction**

There are 2 important kinds of PVC :

1. Rigid PVC which is used in fabrication of pipes and plastic plates.

2. Flexible PVC, which is composed from polymer with addition of plasticizers. This type of PVC used in fabrication of films, coating purposes and production of industrial leathers.[1] So, PVC is one of the most important commercial plastics to its wide applications and low cost. PVC still possess many problems such as low thermal stability and brittleness.[2] PVC without any additives, at room temperature, is a rather rigid material. It is often used in place of glass. But if it is heated above the temperature of 87 C a change occurs, PVC becomes flexible and rubbery.[3]

When compared with PE and PP, unmodified PVC is more rigid, strong, and more solvent sensitive.

PVC is largely used in fabrication of rigid pipes and frames of windows and doors. PVC competes rubber in many applications because of its excellent properties like:[1]

1. High electrical insulation.
2. High resistance for abrasion.
3. Low diffusion for humidity.
4. Good flexibility within range of temperature.

Liling Zhou, Xin Wang and others [4] studied the influence of CPE and ABS copolymer on the mechanical properties of PVC. i.e.... PVC/CPE and PVC/ABS hybrids were examined. The experimental results showed that toughness of the hybrids could be modified greatly by the introduction of the CPE or ABS. The impact strength of PVC/CPE and

PVC/ABS hybrids increased with the content of 2-nd phase.

CPE exhibited a better toughening effect than ABS.

CPE thermoplastic resins are widely used as impact modifiers in PVC extrusion and injection molding applications. Especially effective in products such as window profiles, pipe, and siding, CPE provides excellent corner welt strength and high surface gloss. These resins offer high impact efficiency and perform well at low temperatures, giving very good weather resistance for all climate conditions.

*Mechanical properties of PVC in blend with CPE and UPS:*

*Materials:*

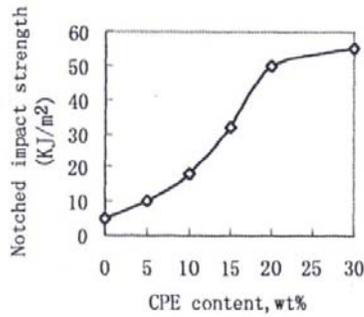
Polyvinyl chloride (PVC) with an average polymerization degree of 1000, produced by Qilu Petrochemi Petrochemical Corp, china. Chlorinated polyethylene (CPE) with 35% weight content of chloride, produced by weifang Chemical factory, china. Ultrafine particles of polystyrene (UPS) with 32% degree of gel and 120 nm average particle diameter.

*Experimental:*

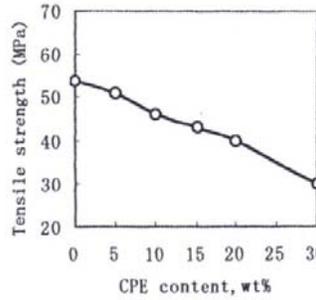
The mechanical properties of PVC/CPE blends change with the amount of CPE, as it shown in figure 1, 2 and, 3. It could be seen that the tensile strength decreased persistently, while the breaking elongation increased and the impact strength various in "S" type curve when the amount of CPE is increased

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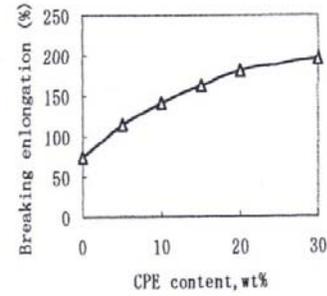
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**Fig. 1:** Notched impact strength versus composition



**Fig. 2:** Tensile strength versus composition



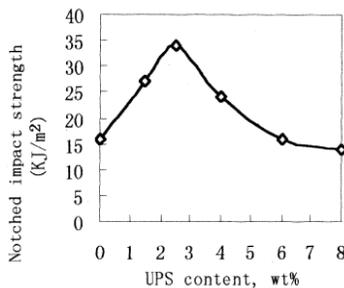
**Fig. 3:** elongation at break versus composition

(The effect of CPE content on the mechanical properties of PVC/CPE (100/variable)):

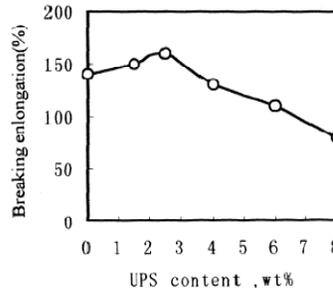
This result is a typical character in the behavior of toughening plastics with elastomer. Ductility of PVC/CPE blends only increase slightly as a small amount of CPE is added, and a mutation region of brittle-ductile transition is formed when 10-20 phr CPE is added into 100 phr PVC (impact strength increased rapidly with CPE amount). After that, the impact strength does not increase obviously but the tensile strength decrease greatly as the CPE amount is increased further.[5-8] This shows the defects and

is important for further improving their combined properties to look for new approaches.

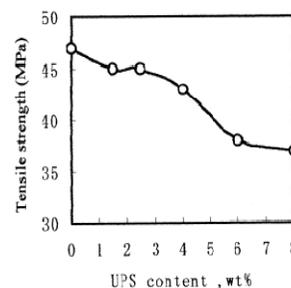
Figure 4, 5, and 6 show the mechanical properties vs UPS content for the PVC/CPE (100/10) blend system. The impact strength of blends increase from 16 to 34 kJ/m<sup>2</sup> as UPS content reaches 2.5 phr, then the impact strength decreases (8 phr). At the same time, breaking elongation and tensile strength changes slightly, as UPS content is within 2.5 phr, and then decreases obviously with the increase of UPS. Good combined properties could be obtained when 2.5 phr UPS is incorporated, but effect of modification for the matrix appears to depend on UPS content.[9-14]



**Fig. 4:** notched impact strength versus UPS content



**Fig. 5:** breaking elongation versus UPS content



**Fig. 6:** tensile strength versus UPS content

(The effect of UPS content on the mechanical properties of PVC/CPE/UPS (100/10/variable)):

**Conclusion:**

It can be seen that PVC/CPE/UPS blend (100/10/2.5) approximately com to the tensile strength of PVC/CPE blend (100/10) and the impact strength of PVC/CPE blend(100/15), i.e. UPS promotes the toughening efficiency of CPE on PVC and only decreases slightly the tensile strength of the toughened matrix.[8-14]

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