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Research Article

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Polyethylene Stability for Structures using Chemical and Physical Vapor Deposition

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Abstract
The aim of this research was to develop methodology on the development of polyethylene composites. The two processes compared where chemical and physical vapor deposition in a chamber. The process parameters where scanning speed and vapor pressure. The response was hatch distance and surface height. The results indicated different surface morphology of concave and convex patterns. The spacing of Intergranular distance of the polymer was double with PVD than with CVD. To give a layer height 30% greater. The reproducibility was high able to develop intricate parts.

Keywords: Vapor Deposition, Hatch Distance, Layer Height

Polyethylene Stability for Structures using Chemical and Physical Vapor Deposition Vapor deposition involved transfer of vaporization particles of a material into a chamber. This was using a mould or a nozzle spray for development of a structure. The material under consideration was polyurethane a composite polymer. These are known for low weight to volume ratio, durability and reusability properties.

Method

Participants

Polyurethane a multi-cross link irrigation vessel and valve were developed using CVD and PVD methods. The CVD used s mould because of the deposition of reactants in a sense of a nozzle. The PVD used a actuated nozzle computer numerical control (CNC) to develop the valve. After the vessel and valve were allowed to solidify under atmospheric pressure (10psi).

Assessments and Measures

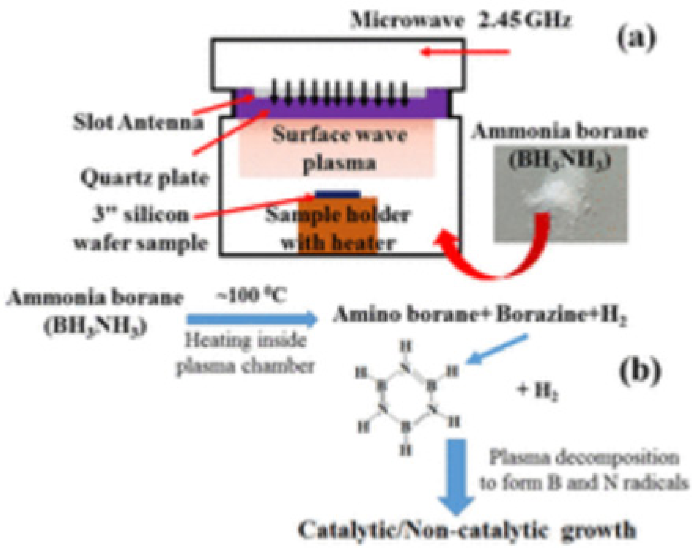
To evaluate the performance of the process the hatch distance and layer height using.spectroscopes. EFM are a highly precise images nanometre in size of parts ranging from millimetres to centimetres. A colour meter was used to observe the melt and solidification pattern in the chamber.

Chemical Vapour Deposition. This is a reactive process which uses catalytic solutes. The chamber has a mould used as a solvent. The vapour was transferred using tubes into the chamber. When the vapour pressure is changed the net balance caused it to settle in the mould. This is a low precision process with noticeable differences. The process settings were used to improve the accuracy.

Physical Vapour Deposition. The mould in this process was place on its side in the direction of the nozzle. This is a kinetic work done unlike CVD which is potential and uses gravity. This was typically used for axisymmetric and symmetric intricate shapes. The research studied the hatch distance and layer height of the valve specimen developed using a colourant for design.

Scanning Speed. This had high accuracy using CNC of 0.4 microns. This parameter was only used in PVD to deposit the liquid polymer. The speed range was from 0 to 5mm in front of the mould. This ensured high equiaxtic solidification of the polyurethane composite in the mould. This was highly versatile to ensure complex shapes, structures and design were in development.

Chamber Pressure. This was common to both processes. The chamber was vented before deposition to a static pressure of 2psi. This was used in previous research as optimum. The particles were vaporized in a separate container. This was supplied to the chamber by tubes. The chamber pressure improves the solidification rate of the polyurethane composite to the mould. Figure 1 showed the chamber were the particles are moulded for 3D production (www.eos.com)

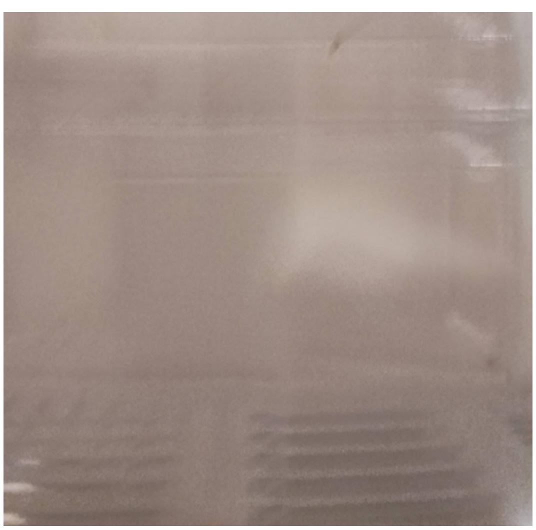


Hatch Distance. This was the Intergranular distance between particles. Each process yield a different hatch distance. Based on the kinetic and potential nature of the solidification rate into the mould. The structure precipitates in solvent form into solute mixture. This can be translucent or opaque dependant on the colourant employment. The greater the hatch distance the more flexible the structure under gradual loads.

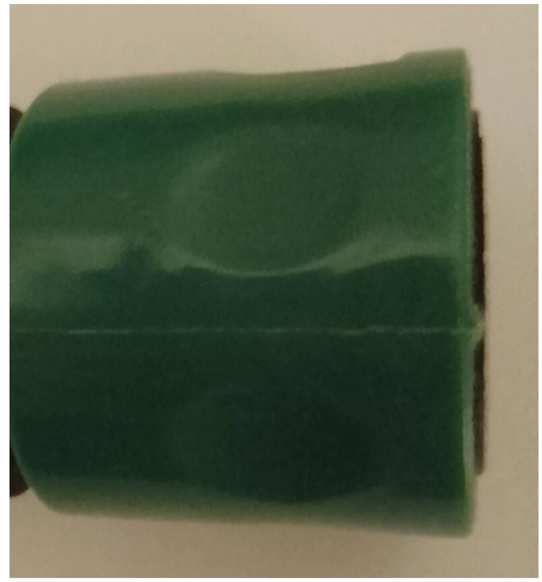
Layer height. Each process has a specific gravity. This is the ratio of actual to water of known value. The effect is various layer heights precipitated on the mould. This affects the durability as the greater the height the more resistant to impact loads.

Results

Each process yielded different hatch distances and layer height. Figure 2 a and b showed the structures developed using CVD and PVD processes.



(a)

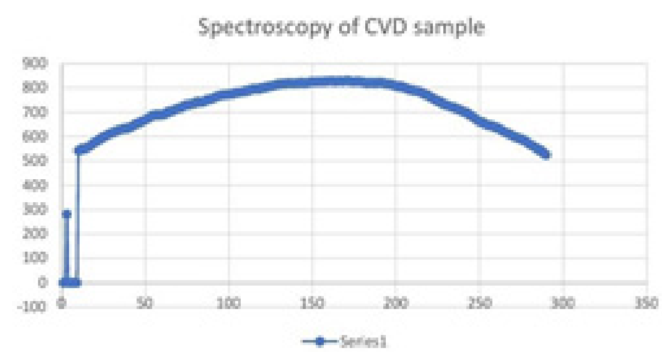


(b)

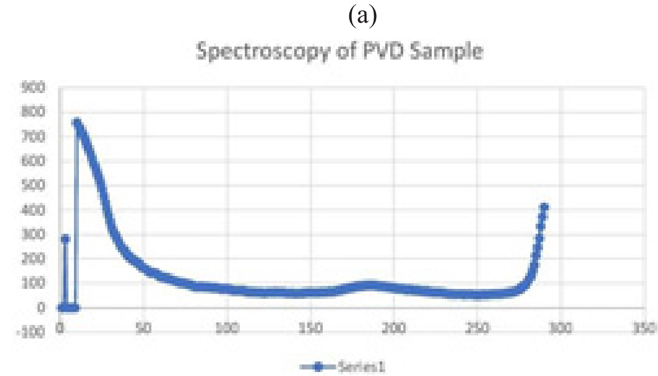
Figure 2: CVD and PVD used to develop (a) vessel (5×10×5mm) and valve (Radii 2cm)

Surface Morphology

Each process developed different structures. The spectroscope scan showed convex structure for CVD and concave for PVD. This was to indicate the former was above the surface and the latter below.



(a)



(b)

Figure 3. Spectroscopy scans of (a) CVD and (b) PVD samples

Hatch Distance and Surface Height

The colour meter indicated a higher vapor and moisture content in CVD. The PVD had a higher luminescence and hence solidification. The result was a greater hatching distance in CVD and lower surface height. The repeatability was higher in PVD over the entire surface using natural processes. The CVD had a greater average and variance of more than 50% in the graph. Figure 4 showed a chart of the spectrum of CVD and PVD sample.

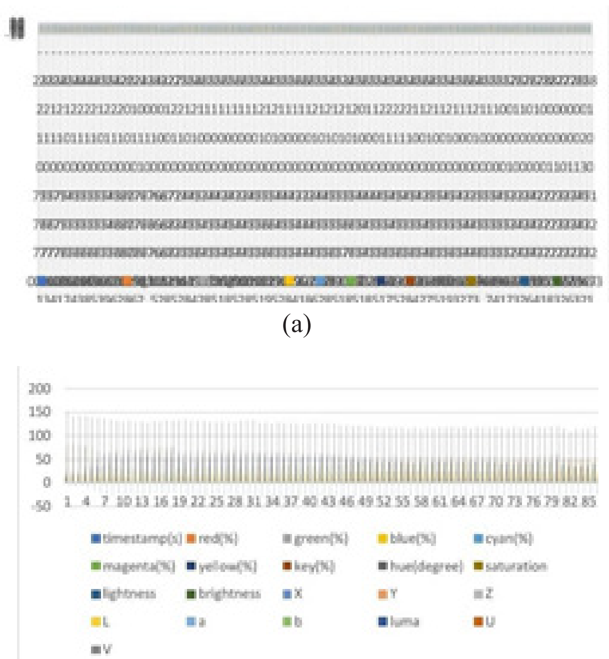


Figure 4: Spectrum colour scans of (a) CVD and (b) PVD samples

Discussion

The spectrum colour meter indicate 20% increase in hatch distance and surface height of CVD samples. This produced an even distribution of polyurethane in the mixture as indicated in Figure 2a. The colour meter for PVD was different and had 10% hatch distance and 75% surface height change to the polymer. This produced a denser structure of uneven distribution of particulate matter.

Conclusion

The CVD should be used for fragile parts with low durability. The dimensions are much greater than in PVD samples. Therefore soil coagulates should not come into contact with CVD polymer. Whereas PVD has a more durable surface and can be used in any condition of irrigation.

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