MACHINING OF POLYETHELENE-ALUMINUM COMPOSITE FROM USED BEVERAGE CARTON WASTE BY MILLING USING HIGH-SPEED CUTTING TOOLS

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Keywords: Polyethylene-aluminum composite, used beverage carton waste, Machining of PolyAl composite

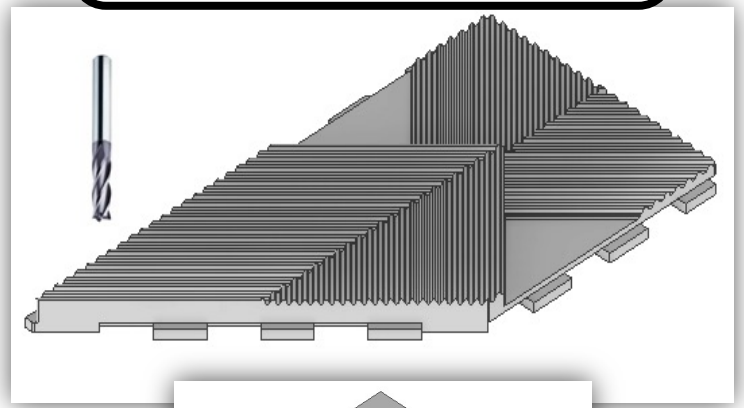
Problem of used beverage carton waste

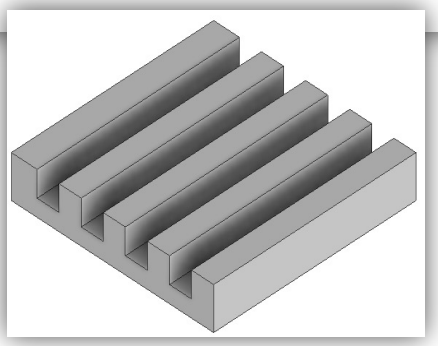
https://wasteorshare.com/milk-carton-can-be-selled/

Cost of mold

https://3dprint.com/259528/thermwood-purdue-3d-printed-composite-molds-to-make-compression-molding-parts/

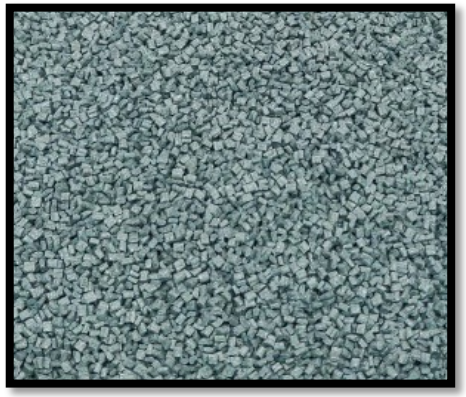
Cutting conditions of PolyAl composite



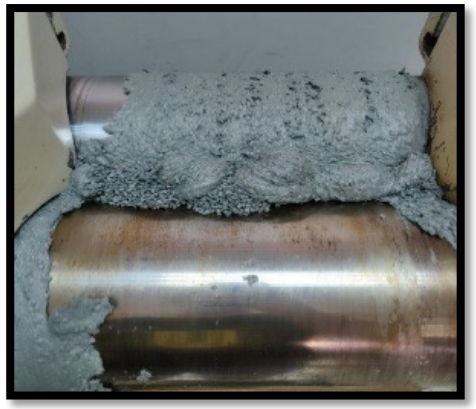


The problem of beverage carton waste, this research would like to use waste from beverage carton waste for making several products, but it found that mold for injection process is high cost. Therefore, it interests to use PolyAl composite for machining process. This research will focus on cutting condition of PolyAl composite

Methodology



PolyAl Pellets



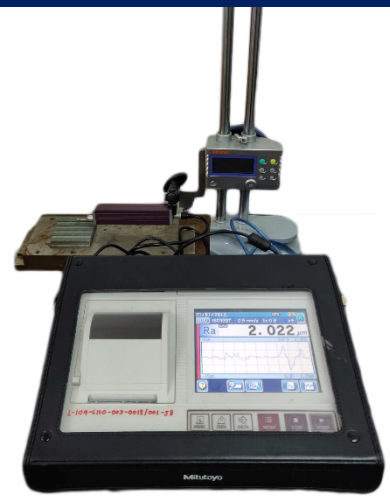
Two roll mill

Compression molding

PolyAl Composite

Preparation of specimens

Specimen for Ra measuring



Surface roughness tester

Machining position by CNC milling machine

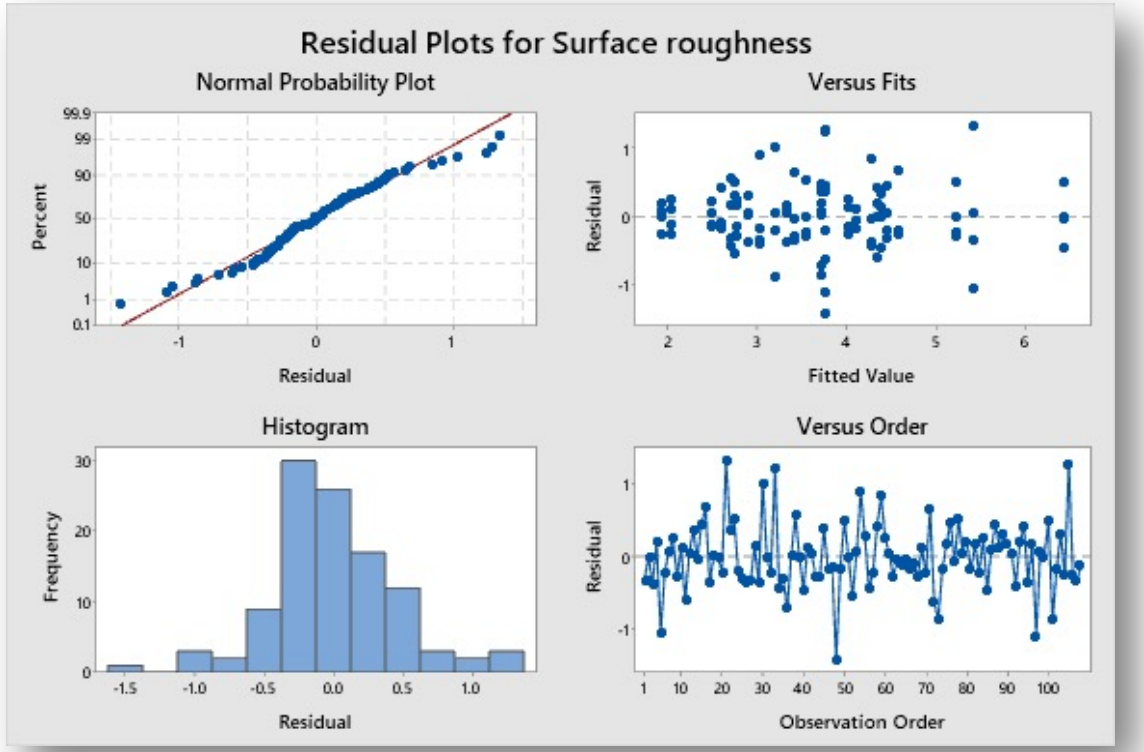
Methodology

Cutting conditions for machining

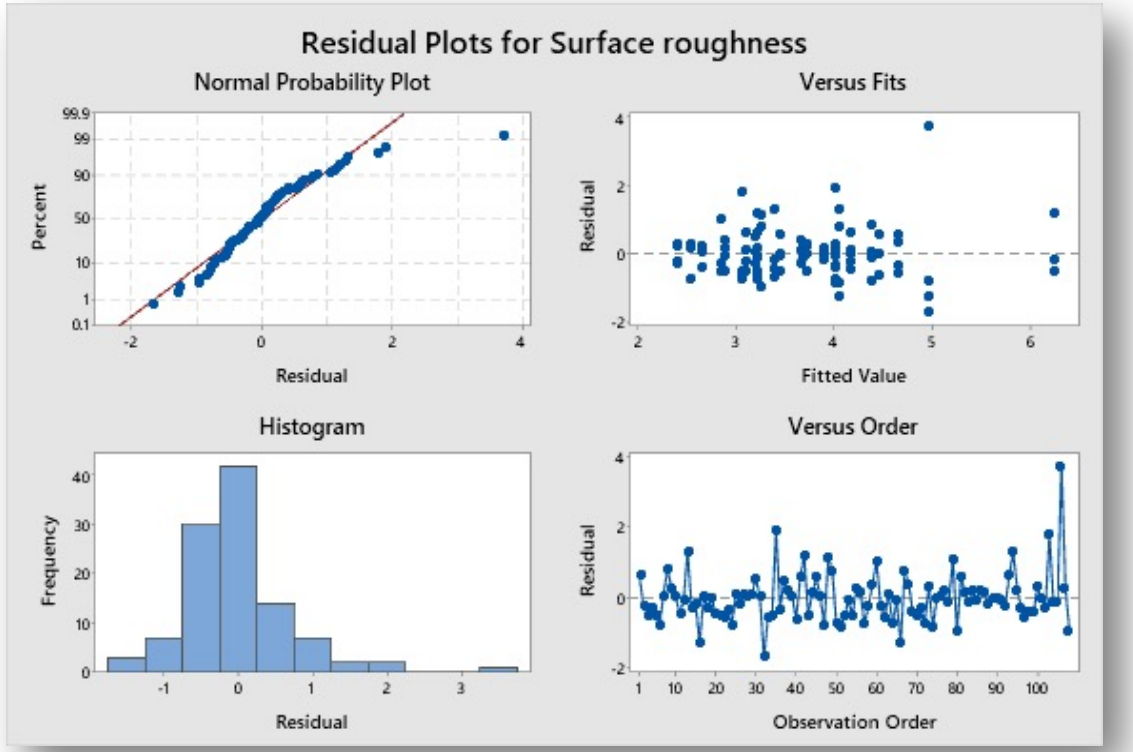
spindle speed (rpm)	500	1000	1500
Feed rate (mm/min)	400	1000	1600
depth of cut (mm)	1	3	6
cutting tools	high speed steel 2 flute, diameter of 6 mm		
spindle speed (rpm)	500	1000	1500
Feed rate (mm/min)	400	1000	1600
depth of cut (mm)	1	3	6
cutting tools	high speed steel 4 flute, diameter of 6 mm		

Results

The machining by 2 flute high speed end mill



The machining by 4 flute high speed end mill



These figures, they found that the results were normal distribution, and variances were constant.

Results

The machining by 2 flute high speed end mill

Source	DF	Adj SS	Adj MS	F-value	P-value
Feed rate (mm/min)	2	3.368	1.684	5.98	0.004
Spindle speed (rpm)	2	66.381	33.191	117.79	0.000
Depth of cut (mm)	2	15.371	7.686	27.27	0.000
Feed rate (mm/min)* Spindle speed (rpm)	4	4.832	1.208	4.29	0.003
Feed rate (mm/min)* Depth of cut (mm)	4	4.582	1.145	4.07	0.005
Spindle speed (rpm)* Depth of cut (mm)	4	4.619	1.154	4.10	0.004
Feed rate (mm/min)* Spindle speed (rpm)* Depth of cut (mm)	8	15.904	1.988	7.06	0.000
Error	81	22.824			
Total	107	137.881			

S = 0.530829 R-Sq = 83.45% R-Sq(adj) = 70.57%

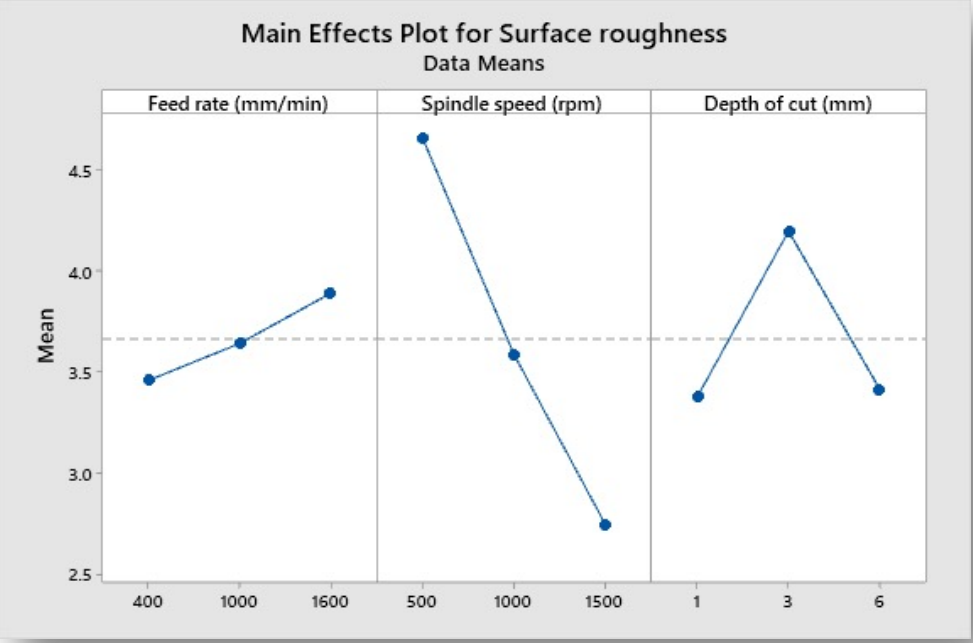
The machining by 4 flute high speed end mill

Source	DF	Adj SS	Adj MS	F-value	P-value
Feed rate (mm/min)	2	1.723	0.861	1.29	0.282
Spindle speed (rpm)	2	35.126	17.563	26.24	0.000
Depth of cut (mm)	2	15.156	7.578	11.32	0.000
Feed rate (mm/min)* Spindle speed (rpm)	4	2.048	0.512	0.77	0.551
Feed rate (mm/min)* Depth of cut (mm)	4	1.619	0.404	0.60	0.660
Spindle speed (rpm)* Depth of cut (mm)	4	6.575	1.644	2.46	0.052
Feed rate (mm/min)* Spindle speed (rpm)* Depth of cut (mm)	8	11.436	1.430	2.14	0.041
Error	81	54.207	0.670		
Total	107	127.89			

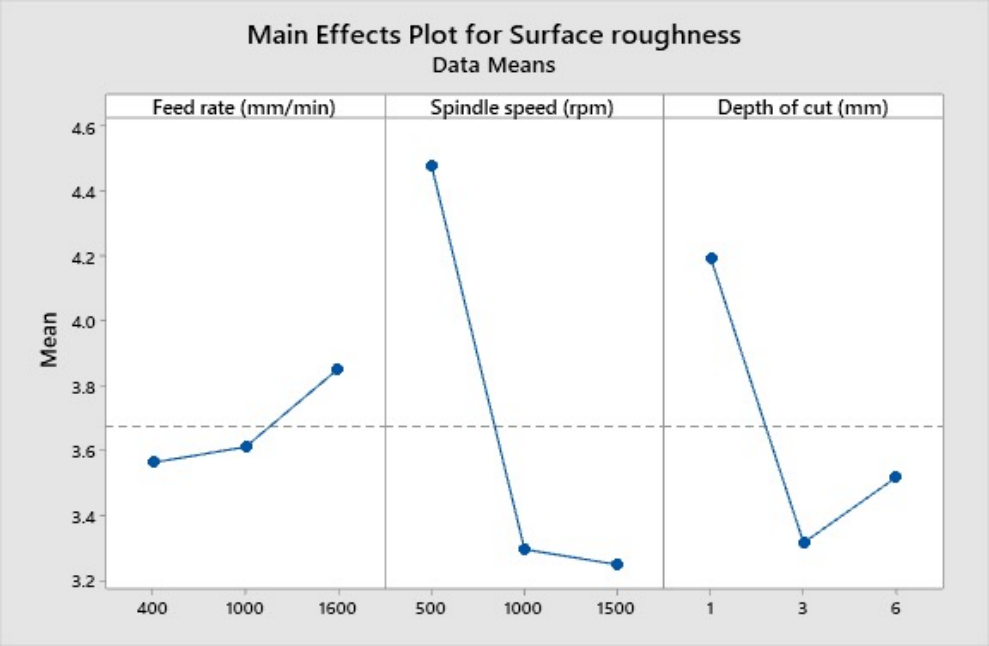
S = 0.818 R-Sq = 57.61% R-Sq(adj) = 44.01%

Results

The machining by 2 flute high speed end mill



The machining by 4 flute high speed end mill

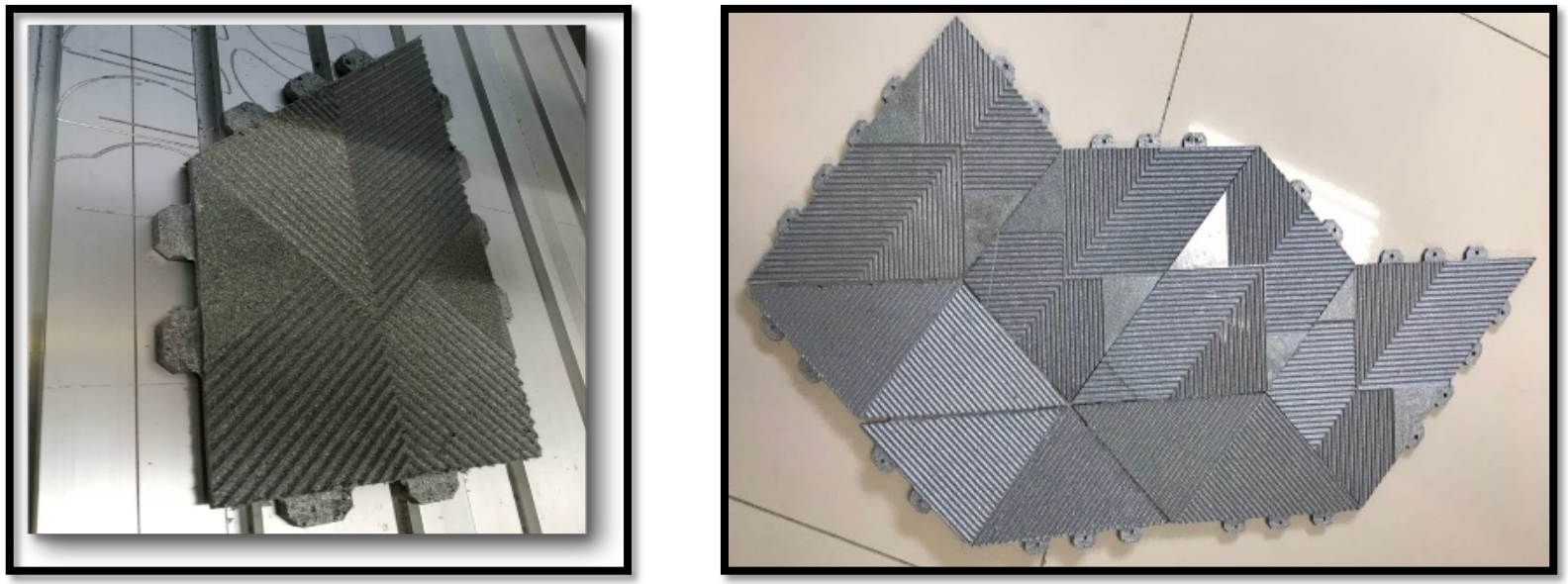


The optimal conditions for machining

High speed end mill	Feed rate(mm/min)	Spindle speed(rpm)	Depth of cut (mm)	R_a
2 flute	400	1500	1	1.91
4 flute	1000	1500	3	2.38

CONCLUSIONS

The results, every conditions can be machining of PolyAL. The value of R_a increased with an increase of feed rate, R_a value decreased with an increase of spindle speed, and R_a value had a tendency to decrease at high depth of cut. In addition, R_a value of machining by 2 flutes end mill was better R_a value than of machining by 4 flutes



3D wall from PolyAl composite by optimal condition