Rewiever comments

Reviewer #1

The manuscript “The utilization of polyvinyl alcohol (PVA) filaments for three-dimensional printing of water-soluble patterns for investment casting,” examines the use of polyvinyl alcohol filaments for 3D printing water-soluble patterns for investment casting. While the use of PVA in 3D printing is well-known, particularly as a support material, the authors should clearly explain how their study advances the existing research.

Comments to improve the quality of the work are listed below:

1) It is recommended to expand the introduction on why PVA, compared to other water-soluble materials, is particularly promising for this application. Highlight specific gaps in existing research that this study addresses.

Answer: The following information was added to the introduction: “Polyvinyl alcohol (PVA) is a water-soluble polymer with the formula (C2H4O)n [11]. It is a particularly suitable candidate for investment casting patterns due to its ability to fully dissolve in water in a relatively short time in comparison with other water-soluble polymers. In addition, it has the following characteristics: it does not produce toxic or harmful solutions after dissolution, it has higher strength than waxes and urea, and it is commercially available as a filament for FDM printing. “

2) Clearly state how this study differs from or builds upon previous work (e.g., new insights into mechanical properties, or mold defects using PVA).

Answer: In introduction part it was stated that this is a first article where the PVA was used as a investment casting pattern material. Thus all data provided are new. We clearly represent what was under investigation and for what purpose: “In order to ascertain the applicability of PVA filaments, a comprehensive analysis of their mechanical properties is imperative. This is due to the fact that the pattern must be capable of withstanding the load during the process of ceramic shell fabrication. Additionally, the dissolution rate of the filaments in water and binder must be examined. The first analysis is used to estimate the time and temperature required for complete dissolution of the pattern, while the second ensures that the pattern dimensions remain unchanged during mold preparation. The conventional investment casting process with wax patterns is known to be accompanied by a number of defects, with known mechanisms of their formation and elimination. The ceramic shell-making and casting process with PVA patterns must provide information about mold and casting defects for this new process.”

3) Figure 7b: It would be beneficial to include the numerical values from the tensile test directly on the graph or consider replacing this part of the figure with a table for clearer presentation and easier reference.

Answer: The numerical values was added to the figure 7b.

4) Figure 10 c: The standard deviation is higher than the mean value in the weigth loss rate in all the experiments, it would be useful to check if the values are representative or if there are errors or extreme values that could affect the interpretation. Also add an ANOVA analysis to determine the significant differences and change the presentation of the values to a table.

Answer: In response to the inquiry regarding the implications of the figure 10 discussion, it is evident that the observed transition from weight gain to weight loss is indicative of a shift in the dissolution rate over time. The low values recorded for the dissolution rate imply that the mean value is nearly zero. Consequently, the standard deviation in this instance is deemed significant and cannot be reduced. This data is crucial in demonstrating the absence of dissolution under typical conditions.

5) Table 2: Add an ANOVA analysis to determine whether the differences in surface roughness are statistically significant. This would provide a more rigorous analysis.

Answer: The error bars provide a clear indication of the absence of a statistically significant difference. This assertion is supported by the results of the analysis of variance (ANOVA) and the calculation of the student criterion, both of which indicate that the observed difference is not statistically significant (refer to the attached figure for further details).

1 ANOVAOneWay (22.01.2025 13:35:54)

Notes

Input Data

Descriptive Statistics

	N Analysis	N Missing	Mean	Standard Deviation	SE of Mean
1	9	0	29,12222	6,74847	2,24949
2	8	0	41,64875	14,63187	5,17315
3	9	0	31,57889	8,83329	2,94443
1l	6	0	35,59833	4,41443	1,80218
2l	9	0	46,70667	17,8822	5,96073
3l	9	0	40,24667	17,91935	5,97312

One Way ANOVA

Overall ANOVA

	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	5	1937,36851	387,4737	2,21079	0,0701
Error	44	7711,63822	175,2645		
Total	49	9649,00672			

Null Hypothesis: The means of all levels are equal.
Alternative Hypothesis: The means of one or more levels are different.
At the 0.05 level, the population means are not significantly different.

Fit Statistics

	R-Square	Coeff Var	Root MSE	Data Mean
	0,20078	0,35291	13,23875	37,5134

Means Comparisons

Tukey Test

Sig equals 1 indicates that the difference of the means is significant at the 0,05 level.
Sig equals 0 indicates that the difference of the means is not significant at the 0,05 level.

6) The conclusion effectively summarizes the key findings of the study but could be strengthened by including more detailed recommendations for future research directions.

Answer: This part was added to the end of the article: "Nevertheless, a number of issues were identified during the course of this study. For instance, elevated roughness was observed in PVA patterns due to the presence of printing layers. In subsequent studies, the exploration of diverse printed surface treatments is expected to yield methods for the smoothing of these printed layers. Additionally, a notable challenge pertains to the extended exposure of the mold to boiling water, a process crucial for effective dissolution of the PVA pattern. This has led to mold de-hardening and failure of thin mold elements. It is imperative to investigate the feasibility of employing dissolution in cold water with intensive stirring or the impact of various additives, such as H_2O_2, on enhancing PVA dissolution."