TESTING PHYSICAL HYPOTHESES USING PROGRAM STATGRAPHICS PLUS

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Abstract

Influence of the composite filler content on the thermal conductivity is measured.

Statistical program is used for testing two hypotheses:
1. The width of the sample is sufficient for the experimental method, 2. thermal conductivity of samples is independent on the weight content of the conductive filler in the sample.

The hypothesis rejection is calculated for the exact probability.

Key words: statistics, composite material, thermal conductivity

1 Introduction

The pulsed dynamic measurement method is applied using the device ISOMET 2104 (Applied Precision, Ltd.) with the surface probe. Experimental parameters of the method are tested using the program Statgraphics Plus5.

The first hypothesis is tested using two measurements of the same sample: with and without the polystyrene mat. The probability is equaled to 0.95 for the hypothesis rejection.

The second hypothesis is tested for samples with the different filler content.

2 Testing hypotheses

The program calculates various statistics and graphs for each sample, and it runs several tests to determine whether there are statistically significant differences between two samples. At the first step it tests whether the samples come from the normal distribution and the result implicates using next analyses. If data indicate significant departures from normality there are used nonparametric tests. Hypotheses are tested for all experimental data. There are 6 samples with the different filler content. The weight content of the strontium ferrite ($SrFe_{12}O_{19}$) is changed from 0% to 50%.

1. hypothesis: whether there are significant differences in data measured with and without polystyrene pad, the first hypothesis is rejected. The F-test in the ANOVA table tests whether there are any significant differences amongst the means. P-value of the F-test is less than 0.05, there is a statistically significant difference between the means of

the samples at the 95.0% confidence level. The Kruskal - Wallis test tests the null hypothesis that the medians are the same. Since the P-value is greater than or equal to 0.05, there is not a statistically significant difference amongst the medians at the 95.0% confidence level. Fig. 1 shows the standard error of each mean, which is a measure of its sampling variability.

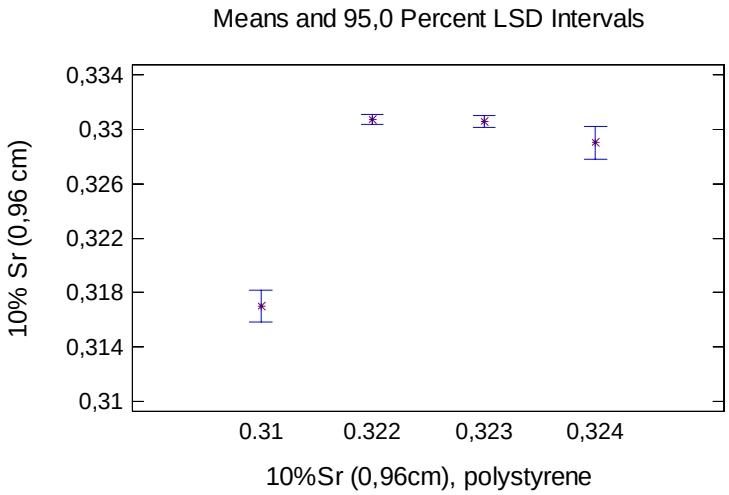

Fig 1 Standard errors of means – Fisher's least significant difference procedure

2. hypothesis: two samples with different weight content of strontium ferrite filler are compared. All samples are measured on the polystyrene pad.
T-test compared the means of the two samples. Since the computed P-value is less than 0.05, we can reject the null hypothesis with probability 0.95.
F-test compares standard deviations of the two samples. There is a significant difference between the standard deviations of the two samples at the 95% confidence level.
We reject the null hypothesis.

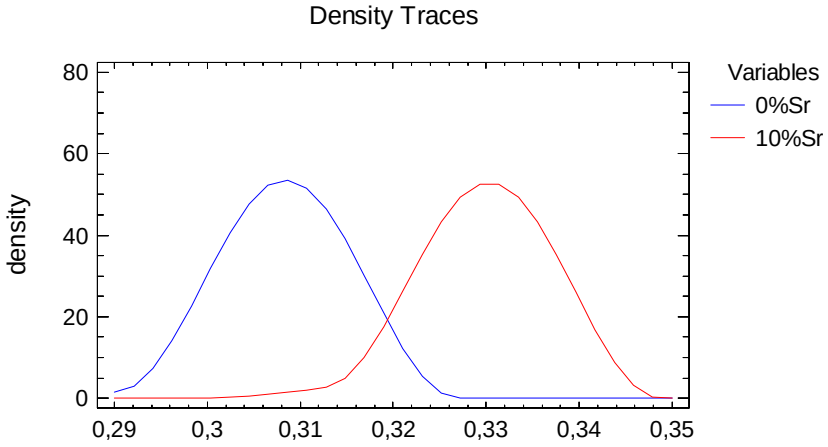

Fig 2 Distribution functions for measured data

3 Conclusion

1. We can reject the hypothesis that the width of the sample is sufficient for measuring without any polystyrene pad.
2. We can not reject hypothesis that thermal conductivity of the sample depends on the weight content of the filler with probability 0.95.

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