MICROWAVE SINTERING OF A TIN BASE ALLOY

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ABSTRACT

The most recent development in microwave applications is in sintering of metal powders, a surprising application, in view of the fact that bulk metals reflect microwaves. In this study, tin base alloy is sintered in a modified domestic microwave oven. The Taguchi Parametric Robust Design, based on orthogonal array (L_8) has been used to plan the experimental conditions, with three replications. The control parameters chosen are sintering temperature, compaction pressure, type of sintering and sintering time. The effect of the control parameters on dimensional change, density, porosity, hardness, and microstructure is studied. Signal-to-noise ratio (S/N) is analyzed through Pareto Analysis of Variance (ANOVA) and iso-level values to arrive at the optimum combination of input parameters for tin base alloys. The conventionally sintered properties and the microwave sintered properties of the specimens are also compared.

It has been concluded that for high overall density, high sintering temperature, high compaction pressure and sintered in a microwave furnace for shorter period of time is required, while for high open porosity, high sintering temperature, low compaction pressure and sintered in a microwave furnace for shorter time period is required. To have high hardness properties, high sintering temperature, low compaction pressure and conventional sintering for larger period minutes is required.

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TABLE OF CONTENT		PAGE

LIST OF FIGURES

LIST OF TABLES

LIST OF SYMBOL

A	Sintering temperature
B	Compaction pressure
C	Type of sintering
D	Sintering time
A x B	Interactions of sintering temperature and compaction pressure
A x C	Interactions of sintering temperature and type of sintering
A x D	Interactions of sintering temperature and sintering time
A_0	140°C
A_1	220°C
B_0	156 MPa
B_1	312 MPa
C_0	Microwave sintering
C_1	Conventional sintering with Argon gas
D_0	30 minutes
D_1	60 minutes
$A_0B_0C_0D_0$	Experiment 1 (140°C, 156 MPa, microwave, 30 min)
$A_0B_0C_1D_1$	Experiment 2 (140°C, 156 MPa, Ar gas, 60 min)
$A_0B_1C_0D_1$	Experiment 3 (140°C, 312 MPa, microwave, 60 min)
$A_0B_1C_1D_0$	Experiment 4 (140°C, 312 MPa, Ar gas, 30 min)
$A_1B_0C_0D_0$	Experiment 5 (220°C, 156 MPa, microwave, 30 min)
$A_1B_0C_1D_1$	Experiment 6 (220°C, 156 MPa, Ar gas, 60 min)
$A_1B_1C_0D_1$	Experiment 7 (220°C, 312 MPa, microwave, 60 min)
$A_1B_1C_1D_0$	Experiment 8 (220°C, 312 MPa, Ar gas, 30 min)
ANOVA	Pareto Analysis of Variance
GHz	Giga Hertz
MHz	Mega Hertz
MPa	Mega Pascal
Sn	Tin
Cu	Copper
Sb	Antimony
SN	Signal to noise ratio
VHN	Vickers Hardness Number
W	Watt
y_1	Raw data of the first replication
y_2	Raw data of the second replication
y_3	Raw data of the third replication

LIST OF SYMBOL

Ψ	Densification parameter
ρs	Sintered density
ρg	Green compact density
ρt	Theoretical density
$\sum$	Sum of