

Use of Computers for manufacturing Processes.

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Abstract :

Computers have been used practically in every aspect of our lives. With the growing trend in computer usage, it is very necessary to find its applications which will make our manufacturing processes better and be easily controlled.

This paper describes some of the practical ways to use computers to assist or monitor simple manufacturing processes. Numerous software's are available in the market and one has to find the most applicable one to suit and adapt for their manufacturing processes.

In the jewelry industry casting temperatures and oven burn-out temperatures are often monitored very meticulously. There are various different types of instruments available for monitoring. Computer monitoring and control of temperatures is described in this paper. The use of computers to assist in printing the casting worksheet is demonstrated in details. Use of computers for engraving and CAD/CAM are briefly described.

Key Words :

Ramp-soak, flat-bed recorders, PID (Proportional Integral Derivative) , SCR (Silicon Controlled Rectifiers, pH, Baume', Algorithm, simulation.

1. Use of Computers in Temperature Monitoring :

The flask burnout cycle is of utmost importance and plays a vital role in the quality of precious metal castings. Almost every manufactured has some ways to monitor and control the burnout temperatures and cycles. Various instruments such as a simple temperature controller or chart recorders are the most commonly used apparatus for monitoring the temperature cycles. Chart recorders come in different kinds such as the flatbed recorders, xy recorders, strip chart recorders and the circular chart recorders. The chart recorders plot the temperature on one axis as the paper progresses in time.

Computer monitoring makes it easy to log the data on a disk for future references and also makes it easy to monitor the cycles remotely. The temperatures are plotted in real time and in the event of any discrepancy, the program also allows for sounding alarms or messages through a speaker system. The programs allows the user to see the temperature on a the screen for each oven and also the real-time plot of temperatures Vs time. Numbers on the axis can be modified to suit the display on the computer screen. Discrepancies in the oven controllers and other operations can be detected easily. In the event of a power failure, controller failure or improper functioning of the burners, the graphs will show the precise time at which these failures had occurred and thereby makes it easy for the operator to decide on the proper corrective burnout cycle again to have proper flask burnout and temperatures. Fig (1), (2), (3), & (4).

2. Use of Computer in Control of Burnout Ovens :

Computers may be used to control the heating of a burnout oven also. Usually the ovens are controlled by a ramp-soak type of controller which will activate a relay which turns on the power to the heating elements in case of electric furnaces or a gas valve for gas fired furnaces. Proportional Integral Derivative (PID) programs allows the computer to supply a proportional power supply to the heating

TEMPERATURE PROFILE OF OVENS
DATE : 18th FEB. 1993.

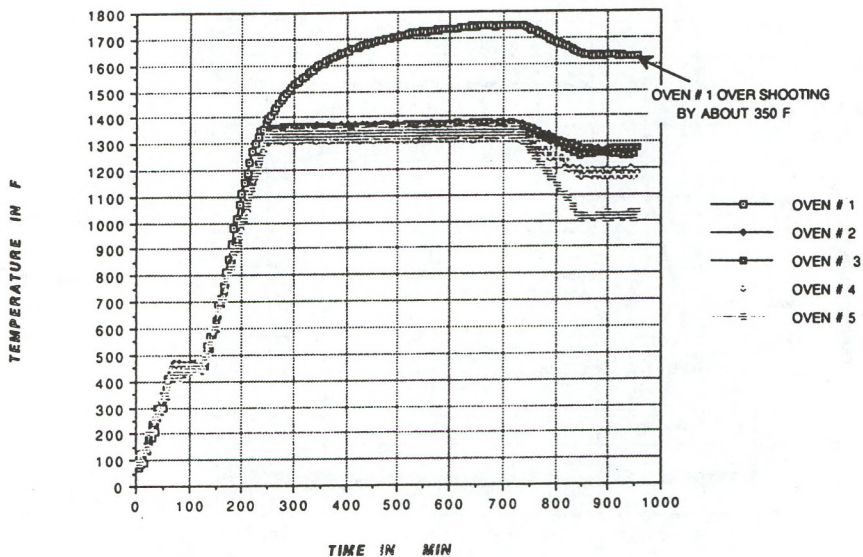
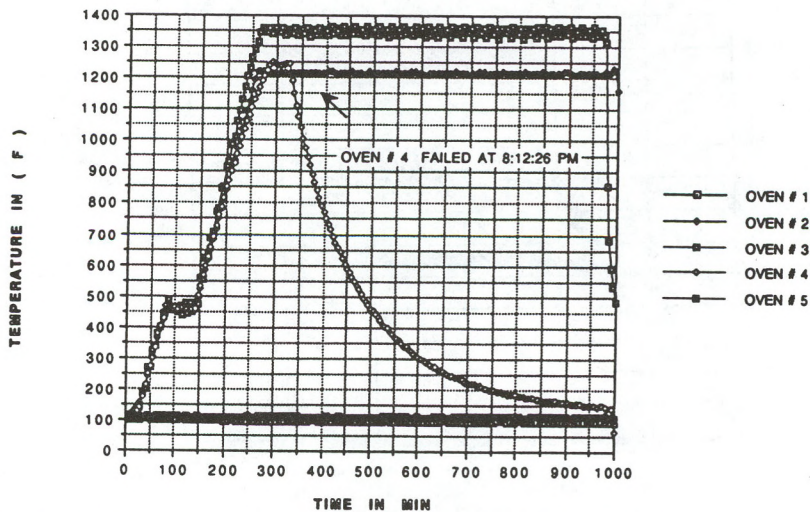


Figure : (1) Temperature Overshoot due to controller failure

TEMPERATURE PROFILE OF OVENS
DATE : 11 TH. OCTOBER 1994.



Oven failure occurred at 8:12:26 pm. Oven had reached final temperature of 1240 and soaked for 49 minutes prior to failure.

Figure : (2) Gas valve failure .

TEMPERATURE PROFILE OF OVENS
DATE : 31 st. JAN. '95

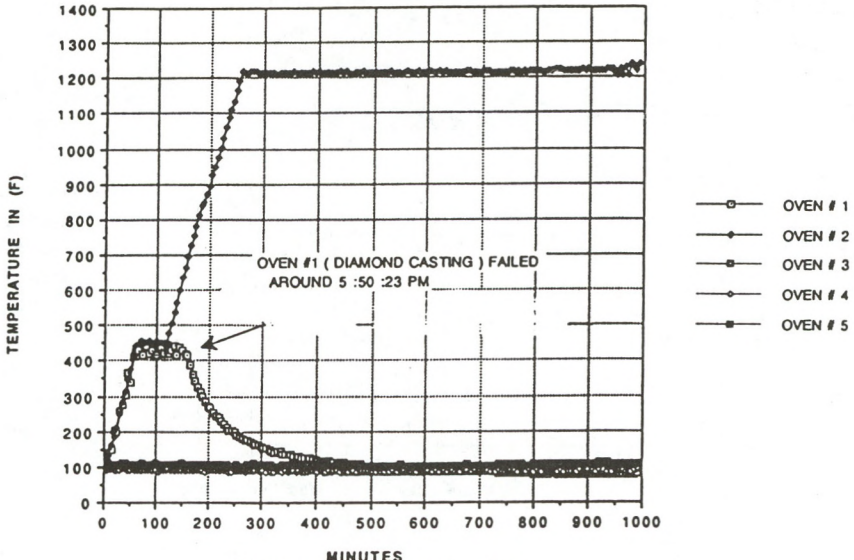


Figure : (3) Controller failure .

TEMPERATURE PROFILE OF OVENS
DATE : 6th. Nov. 1996.

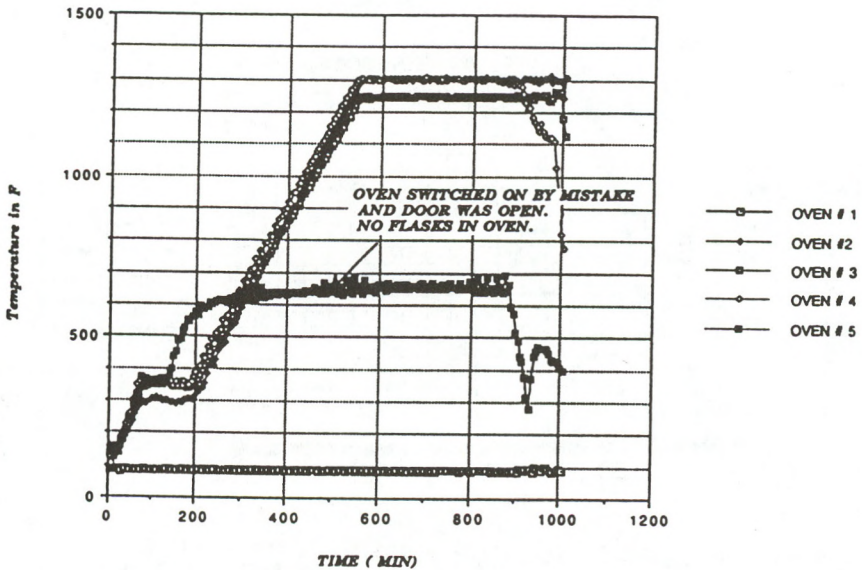


Figure : (4) Human error.

elements through a Silicon Controlled Rectifier (SCR) and for gas fired furnaces, it can adjust the opening of the gas valves to proportionally control the flame in the oven to prevent over or under shooting of temperatures in the oven. This again could be done remotely and many such ovens could be controlled easily using the computer program.

Algorithm for PID control. :

The PID algorithm is defined by the following equation :

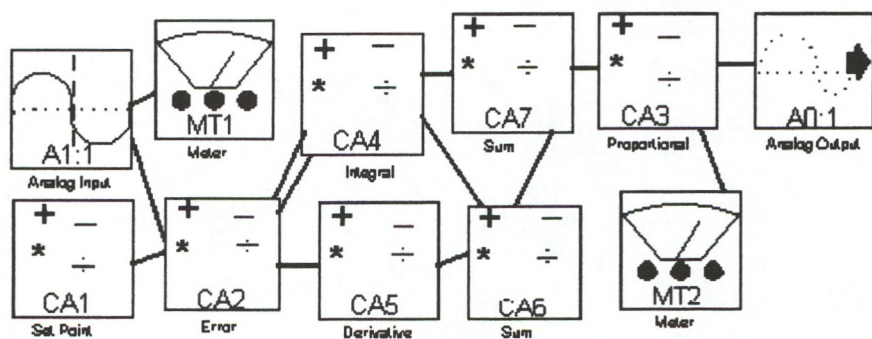
$$m(t) = P\{ e(t) + I \int e(t)dt + D (de/dt) \}$$

Where $m(t)$ = Controller output deviation (analog output)

$e(t)$ = error function as a function of time.

I = reset multiplier

D = Derivative time.



3. Use of computers to monitor and control Electroplating Processes :

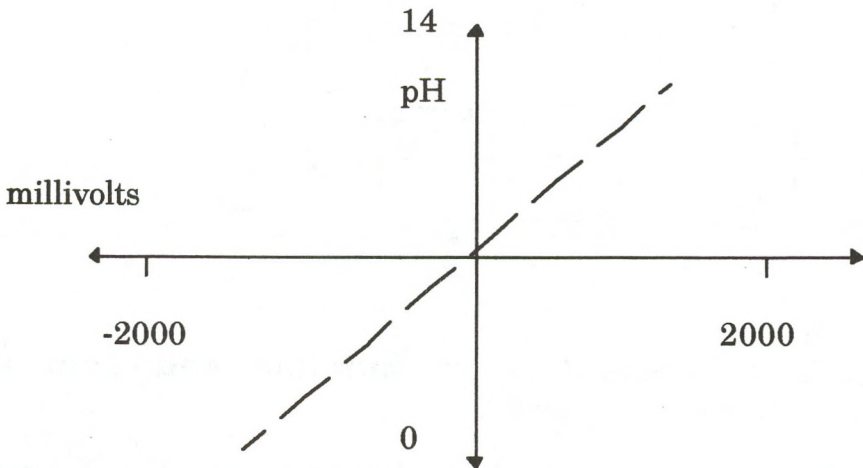
Electroplating involves various chemical baths and it is of great importance to maintain the bath parameters such as temperature, pH , baume' etc. to achieve optimum quality of

plating. Computers may be used to monitor and maintain any bath parameter that could be read as a analog output signal such as temperature of the bath and pH. Output signals may be used to activate a chemical valve to maintain the bath pH or the output signal may be used to switch on or off an immersion bath heater to maintain the bath temperatures.

Algorithm for pH monitoring and control :

$$\text{pH} = (\text{slope} \times \text{Analog Input}) + \text{Constant.}$$

Where Constant is the Analog input for pure water .



Graph showing linear relationship between millivolts output and pH.

4. Use of computer programs for preparing Casting Worksheet. :

Simple computer programs may be developed to reduce labor time involved and also the possibility of error in hand calculation for preparing a Casting Worksheet. Any spreadsheet software like Microsoft Excel may be used to write such programs.

A) Recognition of the type of metal :

Different suffixes may be used to enable the computer to recognize the type of metal such as "10Y" for 10 karat yellow, or "14Y" for 14 karat yellow or "SS " for Sterling Silver and "10W" for 10 karat white gold. Program could then be written to use the correct specific gravity of the respective metal to be used in the calculation of the metal weight for that flask. Certain statistical formulae's may also be added to keep tract of the efficiency of casting for that particular day. Fig : (5).

B) Oven loading schedule :

The metal type may be used in the program again for the computer to recognize and locate the flasks in the correct oven . The oven temperatures may be programmed to change accordingly for some specific reasons. Fig : (6)

5. Computer controlled equipment's. :

With the advancement of technology in the manufacturing areas, more and more equipment's are being developed that is controlled by the computers. Computer controlled equipment's give us the flexibility of a wide range of possibilities in the areas of manufacturing. Computer Aided Drafting and Machining allows the jewelry manufacturer to create numerous artistic designs in a short period of time which otherwise would take longer times and

INVESTING/ CASTING WORKSHEET							YIELD/TW =	58.85
DATE :-		2/22/99					TOTAL =	765 RING
FLASK #	RINGS	FLATS	METALTYPE	BaseWT	TOTAL WAX WT	FACTOR	Metal (Total)	Metal (old)
1Y	60		10Y	100	122	12.5	275	137.5
2Y	80		10Y	98	121	12.5	288	143.8
1K	50	20	14Y	95	114	14.0	266	133.0
1G		80	10G	96	115	14.0	266	133.0
1R		90	10R	96	121	13.0	325	162.5
1W	80	20	10W	97	120	14.0	322	---
2W	60	40	10W	98	115	14.0	238	---
1KW	50	30	14W	101	116	15.0	225	---
1T	40	30	18Y	99	112	15.0	195	---
1S	80	30	SS	100	119	12.0	228	114.0
2S	40	70	SS	94	117	12.0	276	138.0
1A	45	52	A342	99	121	11.0	242	---
1D	60		10D	98	122	12.5	300	150.0
2D	70	20	10D	99	120	12.5	263	131.3
3D	50	40	10D	96	122	12.5	325	162.5
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						---	---	---

Fig : (5) Casting Worksheet showing computerized calculation of Metal.

OVEN LOADING SCHEDULE							
		DATE	2/22/99				
METAL TYPE	FLASK #		1350 F	1300 F	1250 F	1250 F	1050
10Y	1Y		OVEN # 1	OVEN # 2	OVEN # 3	OVEN # 4	OVEN # 5
10Y	2Y		1W	1K	1G	1Y	1D
14Y	1K		2W	1R	1S	2Y	2D
10G	1G		1KW	1A	2S		3D
10R	1R		1T				
10W	1W						
10W	2W						
14W	1KW						
18Y	1T						
SS	1S						
SS	2S						
A342	1A						
10D	1D						
10D	2D						
10D	3D						
0	0						
0	0						

Fig : (6) Computerized Oven Loading Schedule.

sometimes impossible . Software's are now available for computer controlled engraving equipment's, various CAD operations and statistics.

The use of computers to program simple and easy operations of the manufacturing process will help a organization to operate more efficiently . One should look at all the areas where repetitive labor is used in the manufacturing process and try to use computers to do those jobs.

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