

Evaluation Report of Medium Temperature Dry Cabinet

-Evaluation by actual testing

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Purpose of the evaluation--MSD

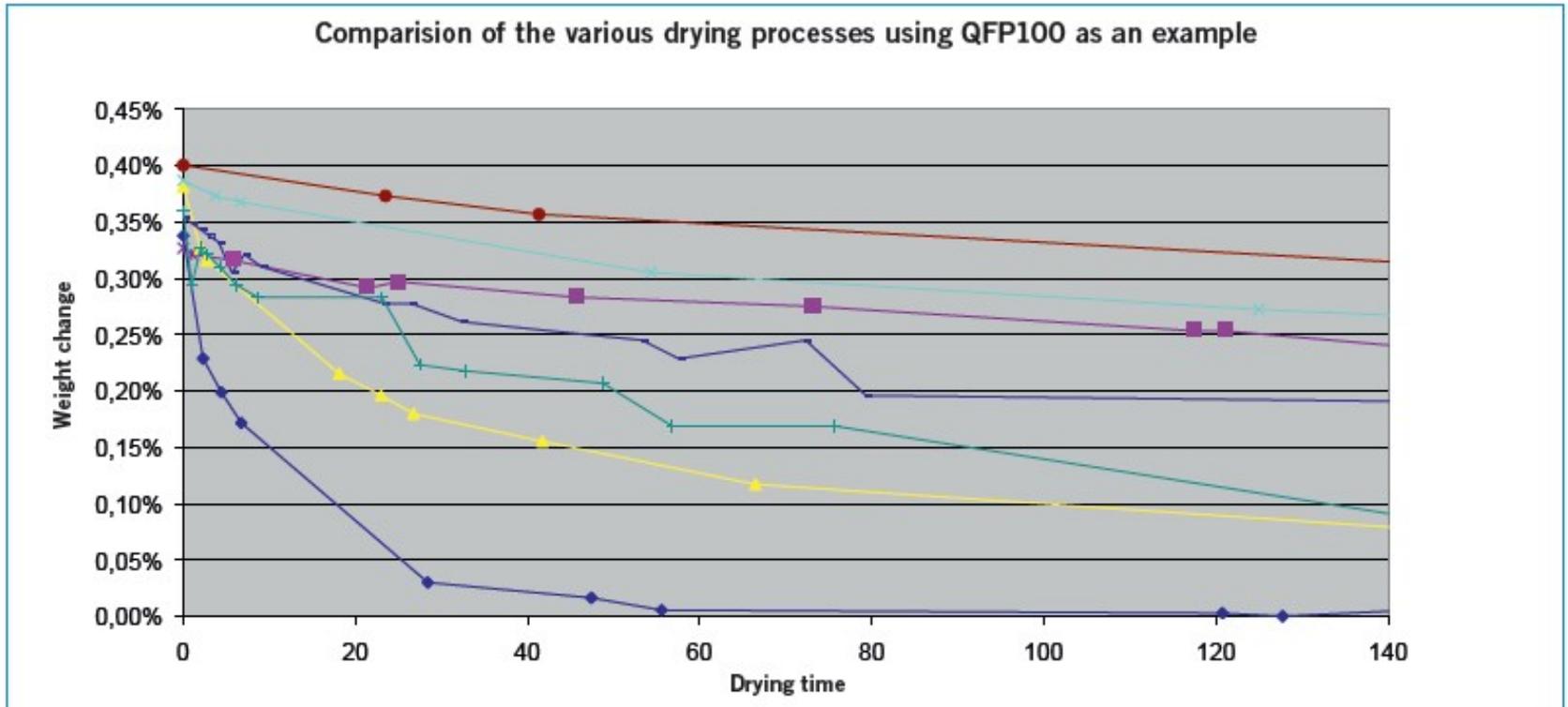
MSD (Moisture Sensitive Device) is mainly referred to non-hermetic SMD components, including plastic IC and other moisture permeable polymeric encapsulation (epoxy resin, organic silicon resin, etc.) The common ICs, Chips, Electro, Leds, etc. all belong to non-hermetic SMD components.

When MSD is exposed in the air, moisture in the air would diffuse and penetrate into the encapsulant material. Then during the SMT soldering process, the moisture inside components would expand fast to cause delamination or even cracking, thus causing damage to the components.

Purpose of the evaluation-- To choose baking method

	Medium temperature baking	High temperature baking
Advantage	<ol style="list-style-type: none"> 1. Mild baking, little damage cause to components 2. Low energy consumption 3. Can used for long term storage and monitor all the time 	<ol style="list-style-type: none"> 1. Fast dehumidification 2. Low cost of the equipment
Disadvantage	<ol style="list-style-type: none"> 1. Dehumidification slower 2. High cost of the equipment 	<ol style="list-style-type: none"> 1. High energy consumption, operating security poor 2. Negative effect in solderability and deformation 3. The storage time must be contolled strictly 4. Special requirement of components' packing material
Conclusion	<p>Is it possible to replace high temperature baking (90°C, 125 °C) by medium temperature/low humidity dry cabinet (40°C, 50 °C, 60°C)?</p>	

2. Comparison of the equipment-- Dehumidifying result (Components)



◆ Baking in oven @ 125°C

◆ Storage in climate test chamber @ 80°C/7% RH

◆ Storage in nitrogen cabinet

+ Drying in dry cabinet @ 60°C/1° RH

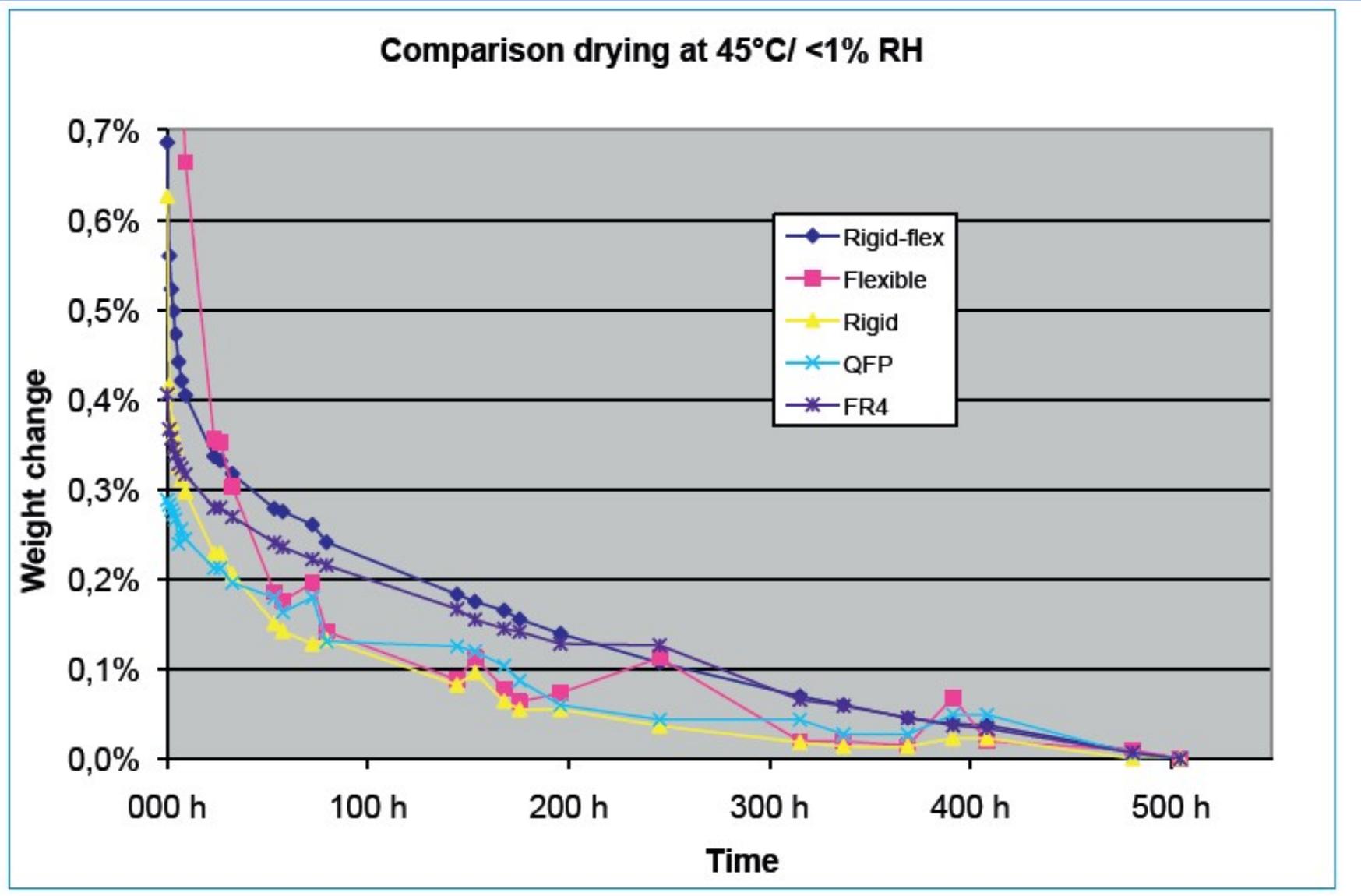
◆ Evacuation with vacuum sealing device @ 80°C

+ Storage in climate test chamber @ 40°C/7% RH

— Drying in dry cabinet @ 45°C/1° RH

Fig.: 1. Different drying methods using QFP100 as an example

2. Comparison of the equipment-- Dehumidifying result (PCBs)



2. Comparison of the equipment– Baking time

Package Body	Level	Bake @ 125 °C +10/-0 °C		Bake @ 90 °C +8/-0 °C ≤5% RH		Bake @ 40 °C +5/-0 °C ≤5% RH		Body Thickness	Level	1%RH HSD/XSD Series				2%RH MSD/SD/SDA Series		5%RH N ₂ Cabinet	
		Exceeding Floor Life by >72 h	Exceeding Floor Life by ≤72 h	Exceeding Floor Life by >72 h	Exceeding Floor Life by ≤72 h	Exceeding Floor Life by >72 h	Exceeding Floor Life by ≤72 h			25C°	40C°	50C°	60C°	25C°	40C°	40C°	30C°
Thickness ≤1.4 mm	2	5 hours	3 hours	17 hours	11 hours	8 days	5 days	Thickness ≤1.4mm	2a	5 days	2 days	1 days	12 hours	7 days	3 days	5 days	23 hours
	2a	7 hours	5 hours	23 hours	13 hours	9 days	7 days		3	8 days	3 days	1.5 days	18 hours	12 hours	5 days	8 days	33 hours
	3	9 hours	7 hours	33 hours	23 hours	13 days	9 days		4	9 days	4 days	2 days	24 hours	13 days	6 days	9 days	37 hours
	4	11 hours	7 hours	37 hours	23 hours	15 days	9 days		5	10 days	5 days	2.5 days	28 hours	14 days	7 days	10 days	41 hours
	5	12 hours	7 hours	41 hours	24 hours	17 days	10 days		5a	10 days	6 days	3 days	36 hours	15 days	9 days	10 days	54 hours
	5a	16 hours	10 hours	54 hours	24 hours	22 days	10 days										
Thickness >1.4 mm ≤2.0 mm	2	18 hours	15 hours	63 hours	2 days	25days	20 days	Thickness >1.4mm ≤2.0mm	2a	22 days	10 days	5 days	2 days	30 days	15 days	22 days	3 days
	2a	21 hours	16 hours	3 days	2 days	29 days	22 days		3	23 days	11 days	5.5 days	2 days	35 days	16 days	23 days	4 days
	3	27 hours	17 hours	4 days	2 days	37 days	23 days		4	28 days	14 days	7 days	3 days	40 days	17 days	28 days	5 days
	4	34 hours	20 hours	5 days	3 days	47 days	28 days		5	35 days	16 days	8 days	4 days	50 days	24 days	35 days	6 days
	5	40 hours	25 hours	6 days	4 days	57 days	35 days		5a	56 days	18 days	9 days	4 days	67 days	27 days	56 days	8 days
	5a	48 hours	40 hours	8 days	6 days	79 days	56 days										
Thickness >2.0 mm ≤4.5 mm	2	48 hours	48 hours	10 days	7 days	79 days	67 days	Thickness >2.0mm ≤4.5mm	2a	67 days	20 days	10 days	5 days	80 days	30 days	67 days	10 days
	2a	48 hours	48 hours	10 days	7 days	79 days	67 days		3	67 days	22 days	11 days	5 days	80 days	31 days	67 days	10 days
	3	48 hours	48 hours	10 days	8 days	79 days	67 days		4	67 days	22 days	11 days	5 days	80 days	31 days	67 days	10 days
	4	48 hours	48 hours	10 days	10 days	79 days	67 days		5	67 days	22 days	11 days	5 days	80 days	31 days	67 days	10 days
	5	48 hours	48 hours	10 days	10 days	79 days	67 days		5a	67 days	22 days	11 days	5 days	80 days	31 days	67 days	10 days
	5a	48 hours	48 hours	10 days	10 days	79 days	67 days										
BGA package >17 mm x 17 mm or any stacked die package	2-5a	96 hours (See Note 2)	As above per package thickness and moisture level	Not applicable	As above per package thickness and moisture level	Not applicable	As above per package thickness and moisture level										

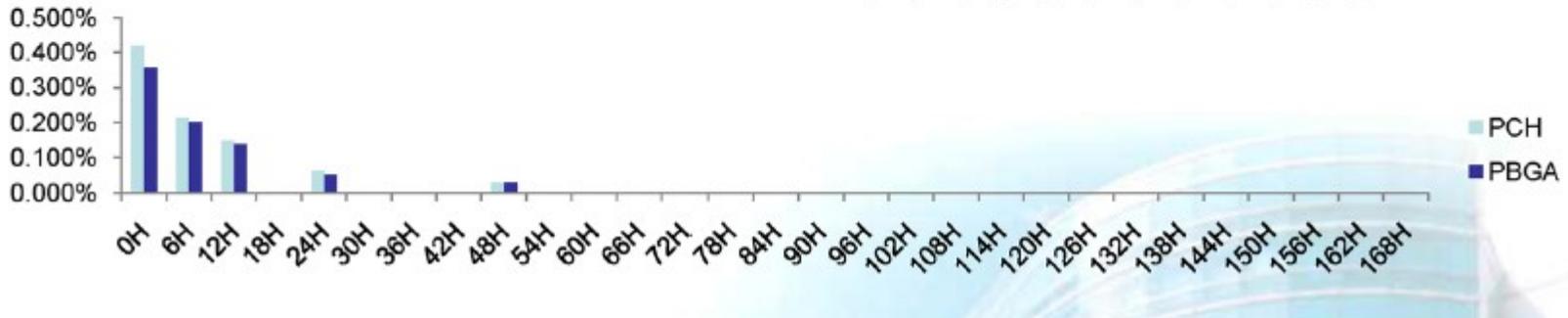
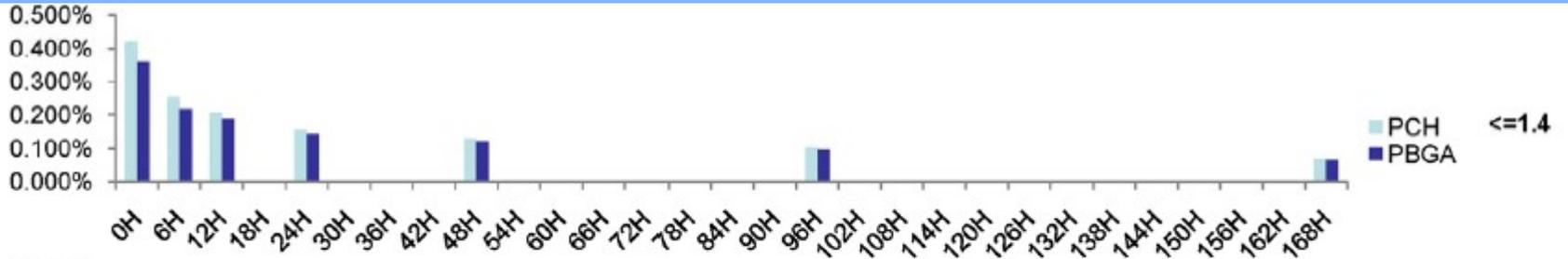
Baking reference of IPC STD-033C

Baking reference of medium temperature baking

3. Experiment Comparison-- Experiment method

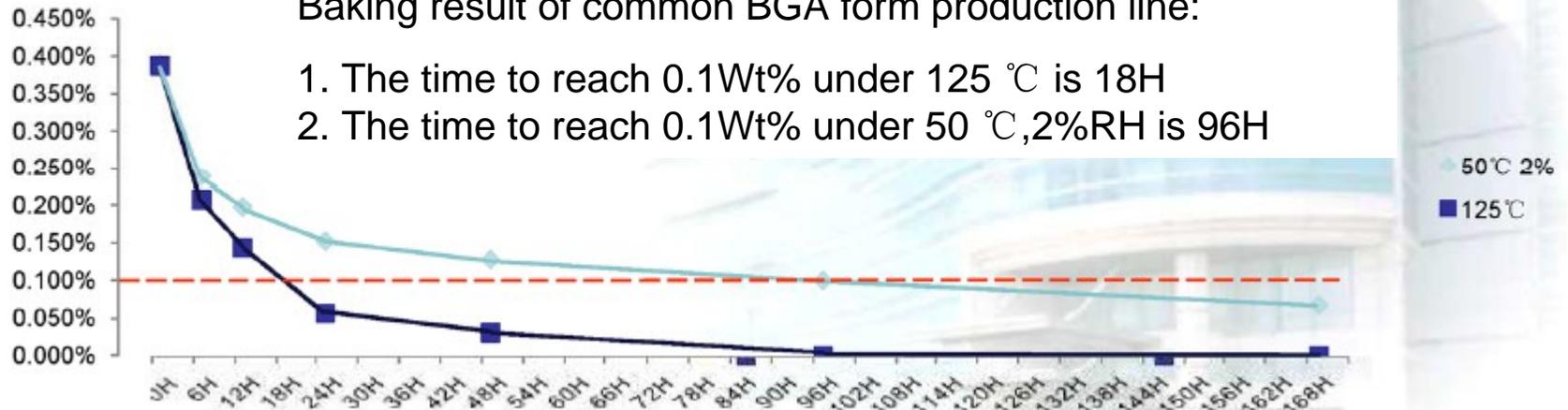
- Samples: Two types of BGA; PCBs with two lengths; common tape materials;
 - Testing standard: IPC-STD-033C; Medium temperature baking reference provided by supplier; Test method of QSMC SMTLAB.
 - Checking method:
 1. Dehumidification effect of medium temperature cabinet:
 - ① Put samples inside baking oven under 125°C to bake till the weight no change;
 - ② Put samples inside temperature humidity chamber till moisture absorption saturated.
 - ③ Then put samples inside medium temperature cabinet, to record storage time and ratio of moisture lose, and test the change of outside appearance.
 2. To heat: Put samples inside SK-5000, to examine and record effect caused during heating.
 3. To measure the warpage of PCBs: To put the saturated PCBs into baking oven and bake under 60°C and 125°C for 48 hrs, take them out and measure the warpage .
 4. To check the outside appearance: To examine with microscope.
- Testing Items: Weight, arrearance, warpage testing, heating examination.

Experiment Comparison-- Dehumidifying result

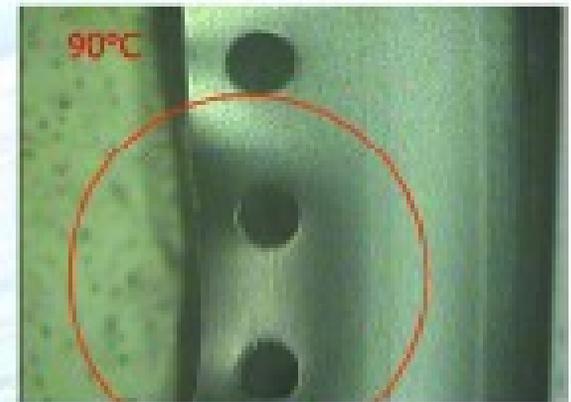
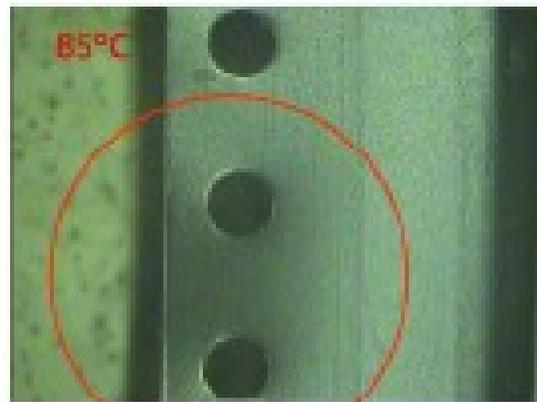
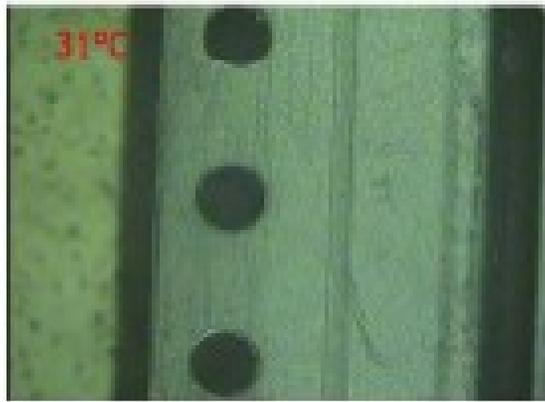


Baking result of common BGA form production line:

1. The time to reach 0.1Wt% under 125 °C is 18H
2. The time to reach 0.1Wt% under 50 °C,2%RH is 96H



Experiment Comparison--Effect on tape material



Clear distortion comes out of common tape material under 85°C.

Experiment Comparison--Summary

	Medium temperature dry cabinet	High temperature baking oven
Dehumidifying effect	Common	Good
Effect on tape packing material	no significant change	Distortion
Color change of the components	no significant change	no significant change
Effect on PCB OSP Pad	no significant change	Become dark
Warpage of PCB	no significant change	no significant change
Spalling of PCB	no significant change	no significant change

Conclusion

Conclusion can be drawn from the above evaluation:

- The high temperature baking oven with high dehumidifying efficiency is still irreplaceable, esp. suits for baking of BGA requesting urgent production;
- The mild environment of medium temperature dry cabinet is well suited for dehumidification and storage of PCBs and components with plastic encapsulation.

So there would be potential need of medium temperature dry cabinets in both production lines and labs.