

The relationship between structure of polyurethane foam sandwich panels and the frequency response

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ABSTRACT A series of classical sandwich composite panels composed of polyurethane (PU) foam core and epoxy laminate or paper panel skin were prepared. The relationships between the compositions or structures of polyurethane (PU) foam and frequency response of distributed mode loudspeaker tested by the conventional methods were studied. The experimental results show that the sensitivity and frequency area of the sandwich panels are effected by the composition, cell size, cell ratio, cell open ratio and thickness. The damping of polymer and the air content in core, the frictional resistance and the reflection on interface acoustic wave transmitting in the sandwich panels are internal causation.

KEY WORDS organic polymer materials, polyurethane foam, sandwich panel, frequency response, loudspeaker

Table 1 The properties of PU foam sandwich panels (paper skin) with various compositions

No.	Mass fraction of polyether	Sensitivity /dB	Frequency area /Hz
	polyol parts		
PU-8	G303 80 PPG220 20	64.6	40~2100
PU-1	G303 100	73.1	50~3800
PU-2	450M 100	78.6	45~7000

Note: Average function of polyether: 2 for PPG220, 3 for G303; Average molecular mass of polyether: 2000 for PPG220, 3000 for G303, 540 for 450M

Table 2 Properties of PU foam sandwich panels with various cell ratio

No.	Cell ratio/%	Density/(g/cm ³)	Sensitivity/dB	Frequency area/Hz
PU-4-paper	98.57	0.189	78.0	33~6500
PU-3-paper	98.19	0.228	78.1	40~6200
PU-6-paper	97.36	0.322	73.6	35~8000
PU-4-ep	98.57	0.325	83.5	60~6700
PU-3-ep	98.19	0.343	73.4	50~6000
PU-6-ep	97.36	0.388	73.9	90~8000

Table 3 Properties of PU foam sandwich panels (paper skin) with various cell size

No.	Cell size/mm	Sensitivity/dB	Frequency area/Hz
PU-22	0.097	62.9	38~8000
PU-21	0.110	65.5	42~7800
PU-23	0.130	66.5	46~7500

Table 4 Properties of PU foam sandwich panels with various cell open ratio

No.	Cell open ratio/%	Sensitivity/dB	Frequency area/Hz
PU-16-paper	2.39	64.8	40~8000
PU-11-paper	2.55	67.3	30~3000
PU-12-paper	2.76	68.3	30~2400
PU-14-paper	4.53	69.9	45~1500
PU-16-ep	2.39	67.1	30~8000
PU-12-ep	2.76	70.0	20~8500
PU-14-ep	4.53	74.9	40~4000

Table 5 Properties of PU foam sandwich panels with various thickness

No.	Thickness/mm	Sensitivity/dB	Frequency area/Hz
PU-3 mm-paper	3	73.1	50~2300
PU-5 mm-paper	5	71.9	50~2000
PU-7 mm-paper	7	67.7	100~2300
PU-10 mm-paper	10	67.4	90~2600
PU-3 mm-ep	3	66.4	30~8000
PU-5 mm-ep	5	64.2	80~9000
PU-7 mm-ep	7	60.8	90~7000
PU-10 mm-ep	10	60.4	110~10000