

CAE TV Speaker Grille

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Optimization Condition for Injection Molding of TV Speaker Grille Using CAE

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: MOLDFLOW CAE S/W A TV speaker grille
 , flow balance, runner balance,
 가 가
 (local database) , standard database
 . Speaker grille flow balance weld line
 weld line
 gas가 . Runner balance gate
 flow balance , weld line
 flow balance runner balance runner
 가
 local database standard database , 가
 , 가 data , 가

ABSTRACT : The optimization condition of injection molding for a commercial product of TV speaker grille of A Company was induced using a CAE software of Moldflow. The flow and packing phase analysis was performed by using flow balance, runner balance, and the intermediate one by using the above two balances, which were used for controlling the amount of packing resins into the cavity. Later, the analysis performed by using the measured viscosity (local database) at various shear rates and the results were compared with the computer simulation using the standard database. Flow balance induced minimized weld line resulted in a better appearance and physical properties of the weld line, but exhibited a disadvantage of large deformation and gas formation due to over - packing of the molten resin in the center of the speaker grille. Runner balance improved the disadvantage of the flow balance by controlling the amount of molten resin injected from the gate, however resulted reduced mechanical properties and poor appearance of the weld line. However, the modified method induced from the flow and runner balance improved the disadvantages by changing the runner size. In addition, the analyses based on the local database and the standard database were compared. Although the measured viscosity was slightly higher and the temperature distribution was broader than the standard database, no distinct difference was obtained from the analysis using the two different databases.

Keywords : CAE (computer aided engineering), flow analysis, packing phase analysis, local database, standard database.

가 Power - law Spencer - Gilmore

가 가

가 Bakerdjian Kamal,⁹

White Dee ¹⁰

Chiang ¹¹

3 가

Sherbelis Friedl

12 가

Malguarnera ¹³

14,15 , Wang

CAE (computer aided engineering)

Moy Kamal ¹⁶

가 , Wang ¹⁷

가 , Cox Mentzer ¹⁸

(weld line), (short CADMOULD,

shot), air trap C - MOLD, MOLDFLOW

Spencer Gilmore ^{1,2}

, Ballman ³ 가

Power law

1 . Load Williams,⁴

Tadmor Gogos ⁵ 가

1 가

Kamal ⁶ 2 , Hele - shaw flow

Tadmor ⁷ 가

가 (equivalent Newtonian viscosity)

FAN (flow analysis network)

, Kamal ⁶ Kenig ⁸

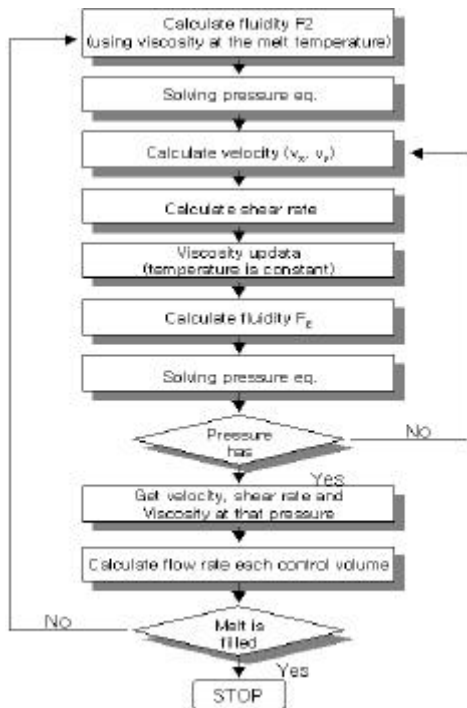


Figure 1. Flow charts for computation of packing phase analysis.

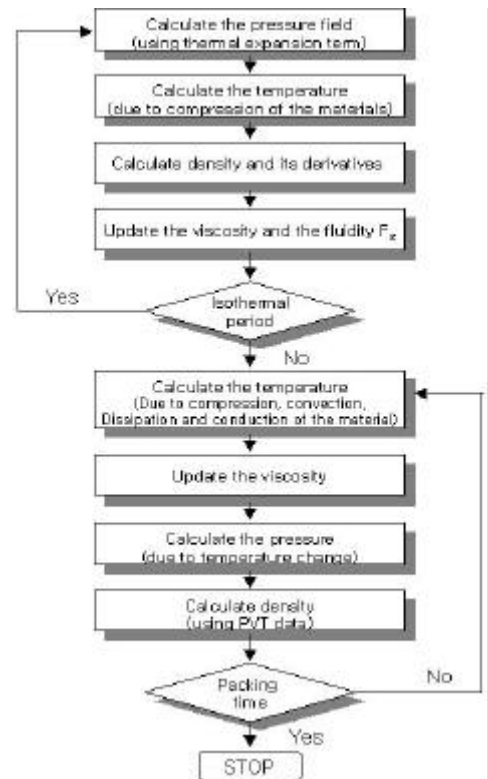


Figure 2. Flow charts for computation of packing phase analysis.

CAE

TV backcover

Flow chart

, backcover

Figure 1 2
Vx Vy x y
Fz z

.20

19

MOLDFLOW

MF/VIEW

, Solver MF/FLOW, MF/COOL, MF/WARP

. CAE

A TV

,21

speaker grille

program

MOLDFLOW

runner balance

$10^{-7} \text{ m}^2/\text{sec}$

MOLDFLOW software

(pseudoplastic flow)

runner balance ,
가

Power - law model, Carreau model,
Cross model, Ellis model, Second Order model
12,22

가

gate
sprue

가 가 gate
gas ,

Tait가 24
(filling
phase) (packing phase) 가

CAE shell mesh
MOLDFLOW
MF/VIEW , Solver MF/FLOW, MF/COOL,
MF/WARP
aspect ratio (
가)
(Non - Newtonian) 가 , 1 5,
1 3

surface , ,

가
(modelling) (meshing),
(derivation of element equations),
(assembly of element equations),
(modelling),
(solution of system equations),
(display results)
(melt history)

Local Database MOLDFLOW
CAE S/W , 2nd
order Master Curve
data
(standard database)
가
data
가

local database
Rosand advanced capillary
extrusion rheometer
Filling Balance. Filling balance flow balance
monitor speaker grille , A TV

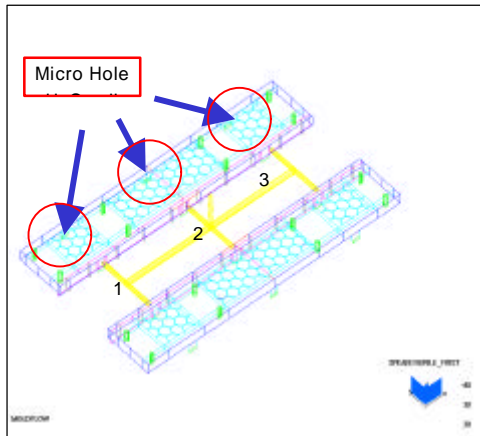


Figure 3. Shape of model used in this study.

Table 1. Specification of the Product

| | |
|-------------------------|--|
| size | length : 463mm width : 83.6mm height : 19.08mm |
| thickness (by color) | green : 2.2mm cyan : 1.4mm blue : 3.0mm purple : 1.62mm red : 1.83mm gray : 1.5mm |
| volume & weight | gross volume : 326.16 [cu.cm] gross weight : 0.304 [kg] |
| resin | K Co. high flowing HIPS |
| application gate | 3 side - gate System(yellow) |

, case 1

가 .

, 가 gate

gate

. case 2

runner

balance

gate

. case 1

double cavity runner system

. Gate ①, ②, ③

Figure 3 ,

Table 1

Filling Balance.

가

case 1 flow balance

runner size

가

. Case 2 runner balance

gate

gas

, case 3

case 1 2

가

• CASE 1 : Flow balance

<Runner ② : 6.8 mm runner ①, runner ③ : 6.0 mm>

• CASE 2 : Runner balance

<Runner ② : 6.0 mm runner ①, runner ③ : 6.8 mm>

• CASE 3 : 가

<runner ①, runner ②, runner ③ : 6.0 mm>

. 가 case

Figure 4(a) , Figure 4(b)

gate

grow

form

가

가 , case 2

Figure 5 weld line

flow balance

case 1

case

2 weld line

. case 2

weld line

case 1 case 2

. case 3

case 1 case 2

flow balance

runner balance 가

가

case 3

Figure 6(a) 6(b)

227.50 231.97 °C

가 4.47 °C

20 °C

speaker grille

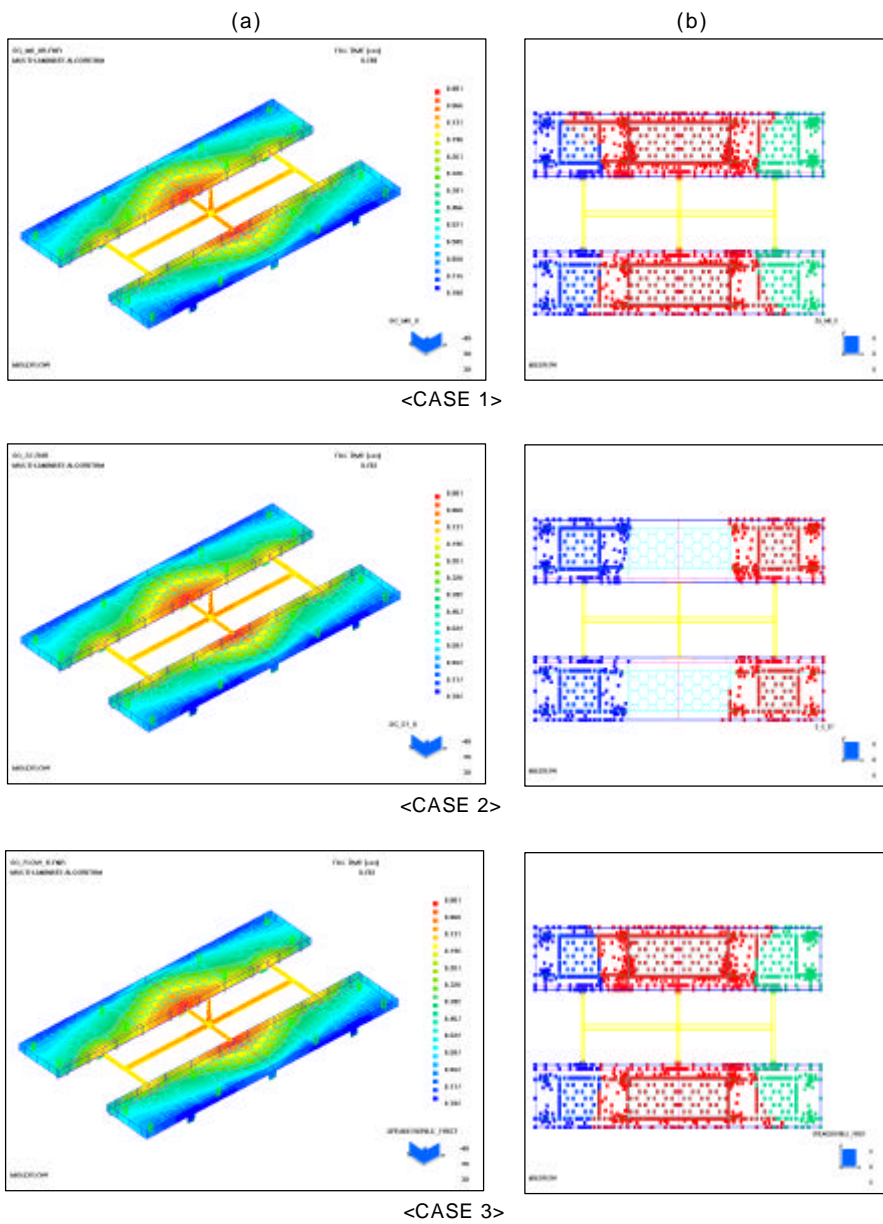


Figure 4. (a) Flow patterns of the resin and (b) growth form in each CASE.

가 가

5%

가 Figure 11

standard database

10.37%

가

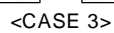
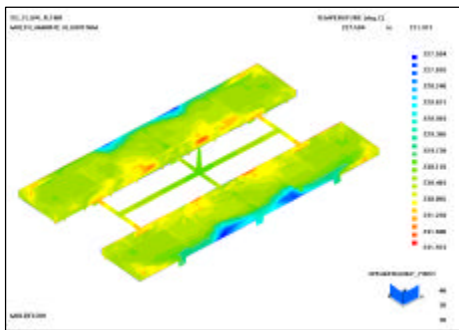
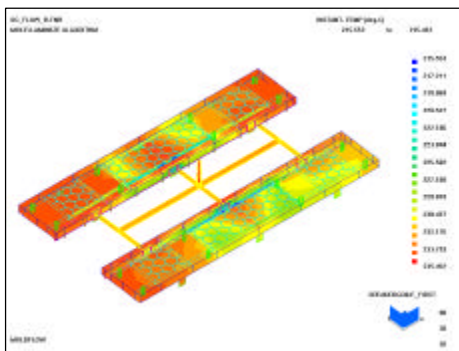


Figure 5. Weld line distribution in each CASE.

Figure 8

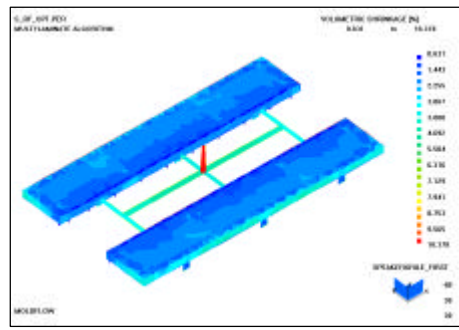


(a)

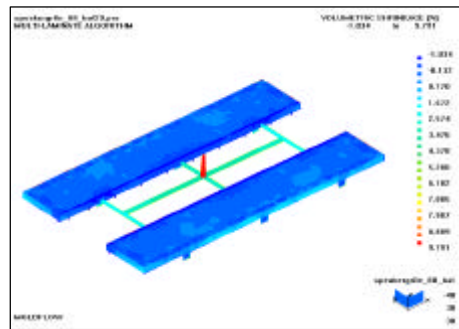


(b)

Figure 6. Temperature distribution (a) during filling and (b) after filling resin.



<Standard data>



<Local data>

Figure 7. Comparison of volumetric shrinkage of the standard database and local database.

Local Database Standard local
database master curve

Figure 9

가 database 가 speaker grille
가 Figure 10

가

database local

222.8 233.2 °C standard database
227.5 232.0 °C 가 5.5 °C

Figure 11

가

가 Figure 7

5%
가 standard database
local database 가

가 가

가

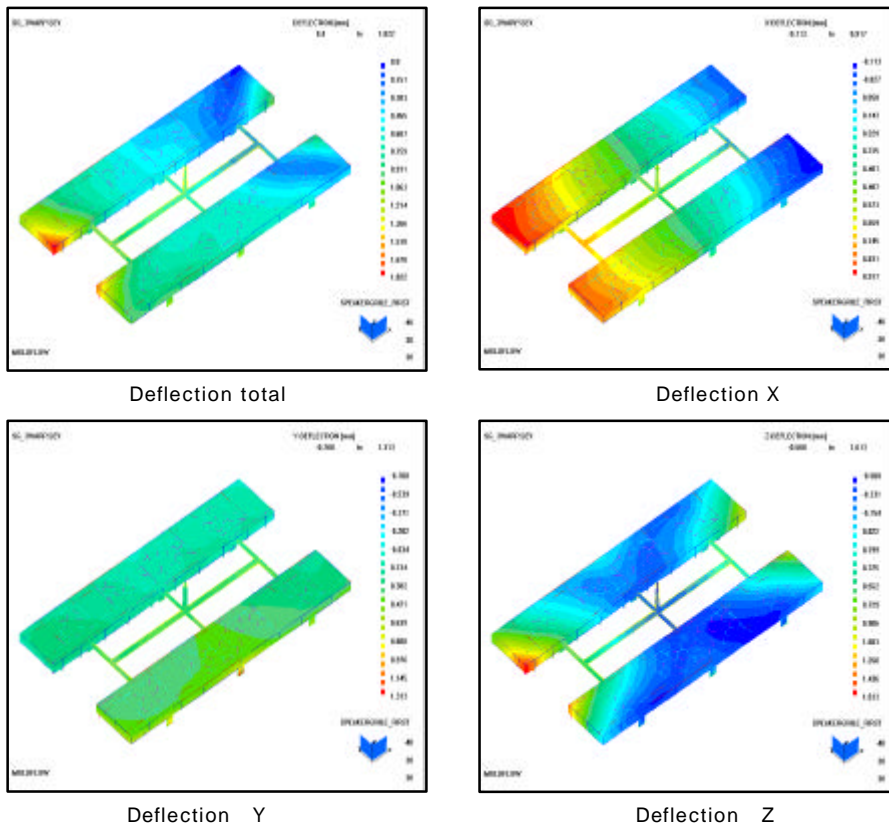


Figure 8. Deformation analysis in total and each axis.

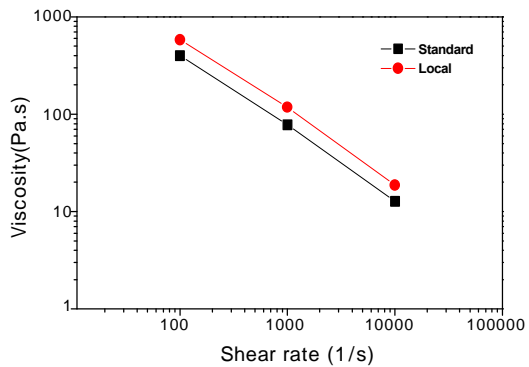


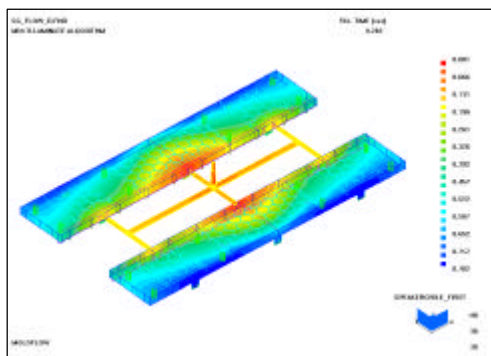
Figure 9. Experimental data of shear rates vs. viscosity at 220 °C.

standard
database

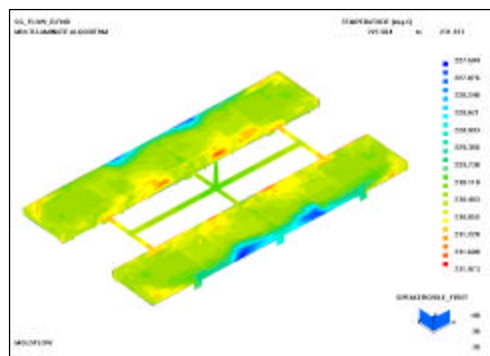
1) Speaker grille flow balance
weld line weld
line
가
gas 가 가

2) Runner balance gate
1)
, weld line
가

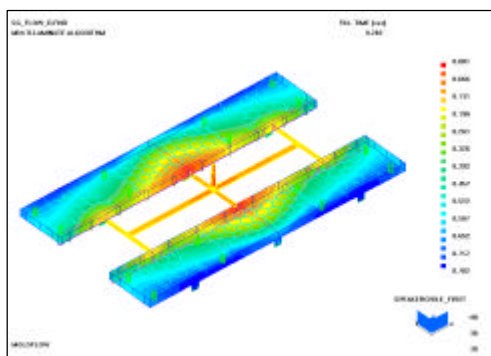
3) Flow balance runner balance
runner size



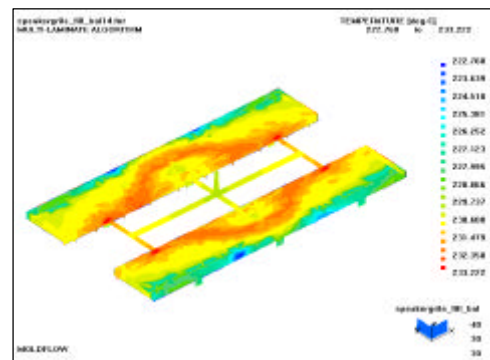
<Standard data>



<Standard data>



<Local data>



<Local data>

Figure 10. Comparison of flow pattern by the standard and local database.

Figure 11. Comparison of temperature distribution during filling by the standard database and local database.

, weld line
 gas 가
 4)
 local database , standard
 database , 가
 , 가

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