

最新真实三维实体CAE模流分析 研发与应用成果



科盛科技Moldex3D
楊文禮 总经理

R12.0

科盛科技与Moldex3D简介

- > 成立于**1995**年，为全球最大的独立模流分析软件与技术服务提供商，专业团队超过**240**人
- > 研发总部位于台湾新竹，技术服务中心分别位于苏州、东莞、厦门、台北、台中、台南、底特律、曼谷、清奈
- > 全球工业用户超过**2100**家，客户服务案件超过**8,000**件
- > 自有先进材料实验室，可提供客户最即时、最完整的塑料模流分析参数鉴定服务

Mold-Masters 以Moldex3D作为全球标准分析工具

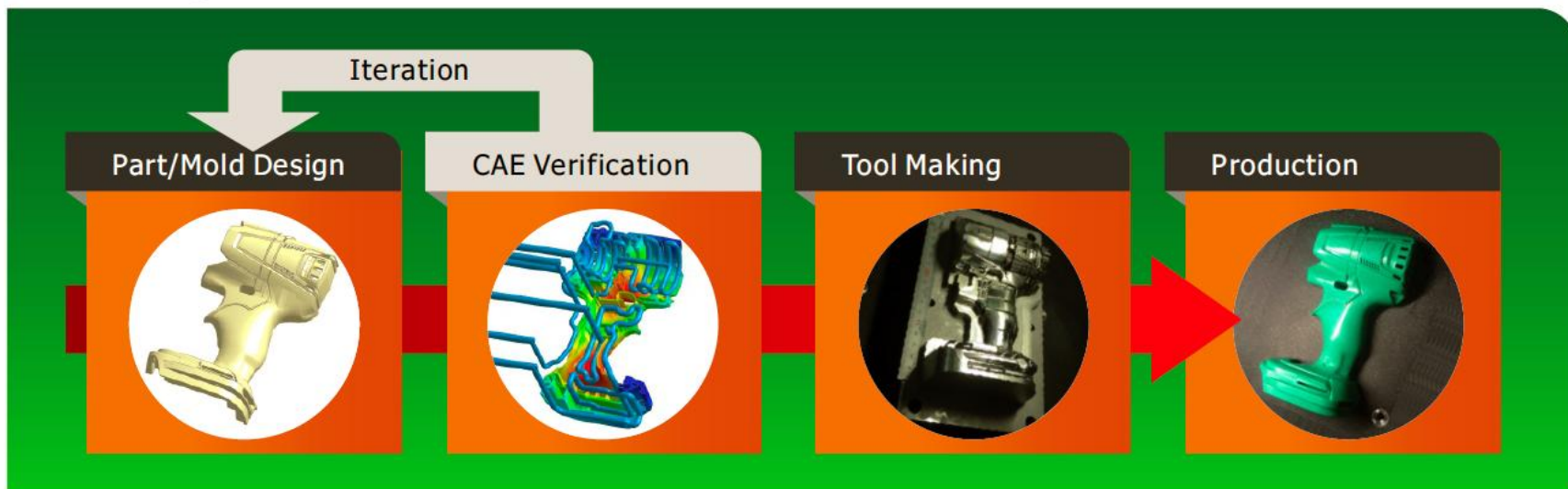


Hans Hagelstein
President, Global Engineering

Mold-Masters Global Engineering 总经理

Hans Hagelstein表示：「我们在这50年来的企业经营中，**Mold-Masters**从未打算在研发上走捷径，我们只选择最好的，而不是最简单最容易的路。」**「我们不断寻找最好的工程分析软体，帮助我们深度了解与最佳化熔胶传递系统和控制技术。选择Moldex3D是因为它有我们在寻找的独一无二技术，其精密写实的三维模拟结果与进阶的热浇道分析功能，不仅为企业建立CAE分析标准，更有助于深入技术与研究开发。」**

基于Moldex3D的产品设计与模具优化



设计验证

- CAD/PLM完全集成
- 自动、方便易用的网格生成
- 分析正确性与回应速度

创新增值

- 先进网格技术
- 支持先进制程
- 深入的解析与优化

從產品設計到模具設計到創新加值的完整方案

產品設計驗證

**NX EasyFill
eDesign Basic**

- 決定澆口位置與數目
- 確認成型性
- 避免不良縫合線與包氣

模具優化設計

**Moldex3D
eDesign**

- 與尺寸
- 決定流道管徑與配置
- 預測收縮與凹痕
- 強化並平衡冷卻設計
- 控制翹曲變形
- 優化纖維配向與產品強度
- 使用FEA驗證結構強度

追求創新加值

**Moldex3D
Advanced**

- 超薄件成型
- 研究革新性製程技術
- 創新加值製程

Siemens NX 搭载Moldex3D充填分析

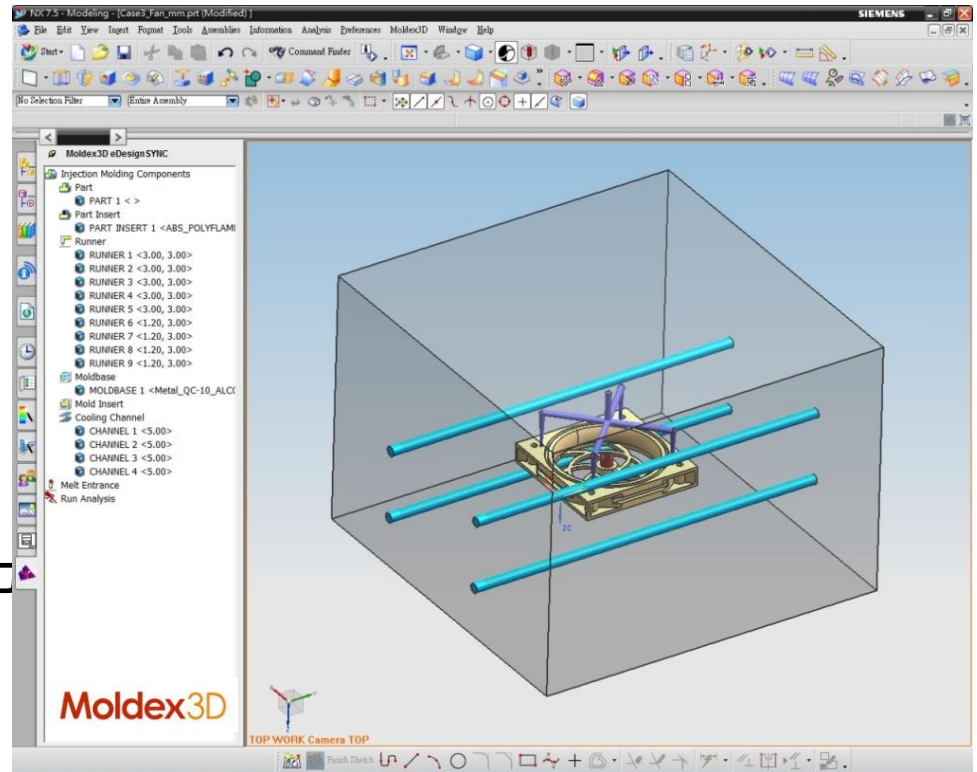
Siemens NX平台引进Moldex3D模具充填制程模拟技术



Siemens PLM Software产品工程软体资深副总**Jim Rusk**表示：「**NX**已被全球许多产业作为高阶塑件设计与模具开发软体的使用标准，我们相信引进**Moldex3D**专业CAE模流分析技术，将更进一步提升客户在预先设计验证与解决设计瓶颈上的能力。此次**NX 8.5**整合的**EasyFill Analysis**模流分析功能展现我们对客户的承诺，提供客户塑胶产品的设计与制造模拟解决方案。」

Moldex3D在NX, Creo与SolidWorks的完全集成

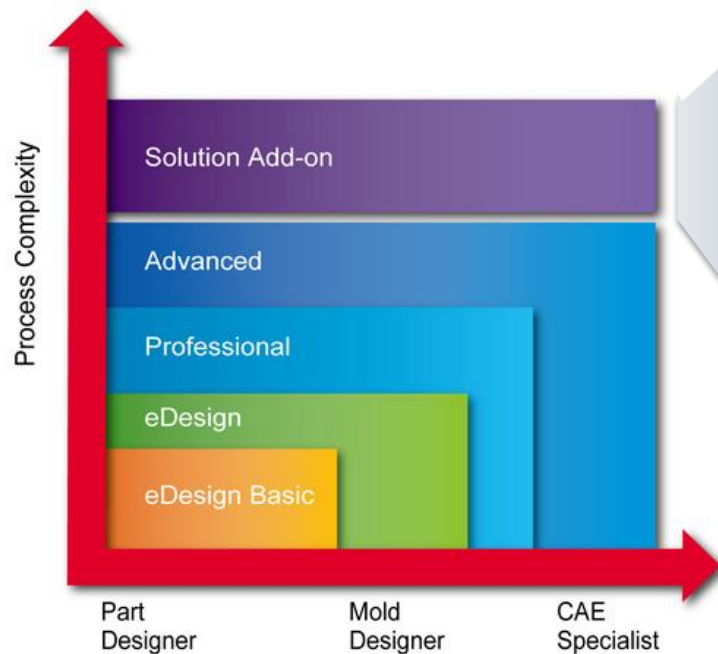
- > 前处理与后处理完全集成于CAD环境
- > 支援各种常见分析类型
 - 充填分析
 - 保压分析
 - 冷却分析
 - 翘曲变形
 - 纤维排向
 - 嵌入成型
 - 双色成型
- > 可直接局部修改模型，优化设计



Moldex3D 产品解决方案系列

- **Moldex3D提供專業模流分析技術以及完整的射出成型解決方案以協助全球各產業客戶大幅改善產品品質**

针对业界特殊制程研发的扩充元件



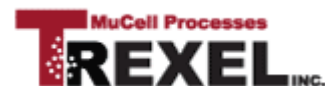
- 纤维配向模组
 - 进阶热浇道分析模组
 - 异型水路分析模组
 - 共射出模组
 - 气体辅助射出成型模组
 - 水辅助射出成型模组
 - 双料共设成型模组
 - 粉末注射成型模组
 - 压缩成型模组
 - 射出压缩成型模组
 - 专家分析模组
 - FEA 介面功能模组
 - Digimat 介面功能模组
 - 微细发泡射出成型模组
- Mucell®**

整合先进成形技术

> 与德国EOS与日本OPM合作，提供随形冷却的设计技术



> 为Trexel微细发泡技术 MuCell® 的全球唯一模流分析技术夥伴



> 与日本Elysium合作提供CAD模型的修复工具Moldex3D CADdoctor



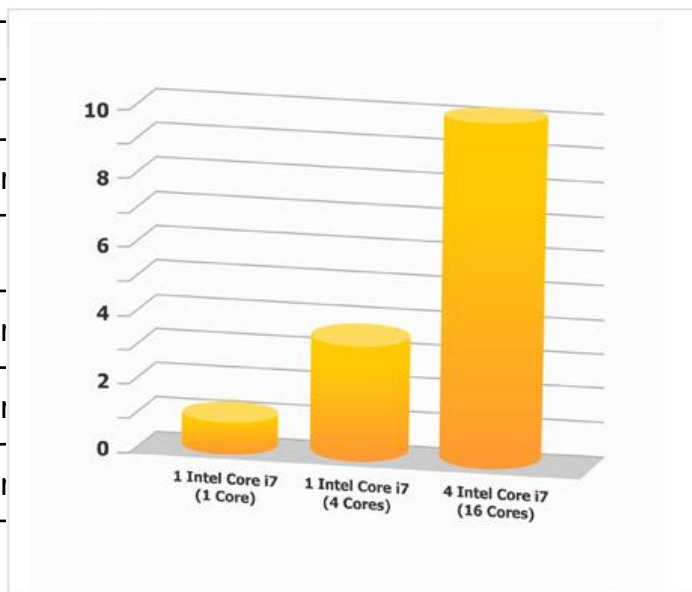
> 与Compuplast独家合作注塑螺杆设计分析工具Moldex3D ScrewPlus



持续领先的计算效能

- > 流动分析速度每个版本平均提速**20%**
- > 所有分析功能支援并行计算
- > 业界最佳的平行分析效能，支援丛集计算

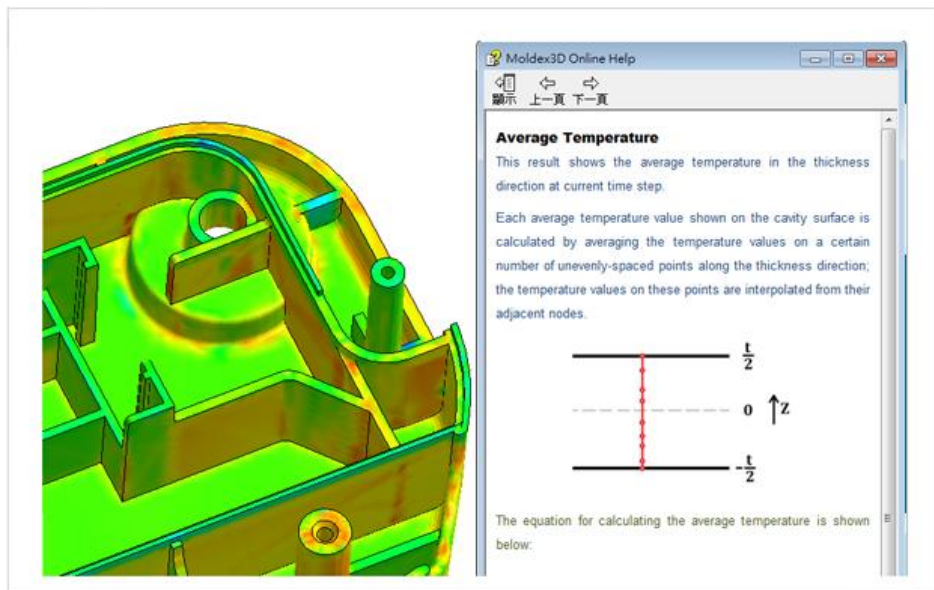
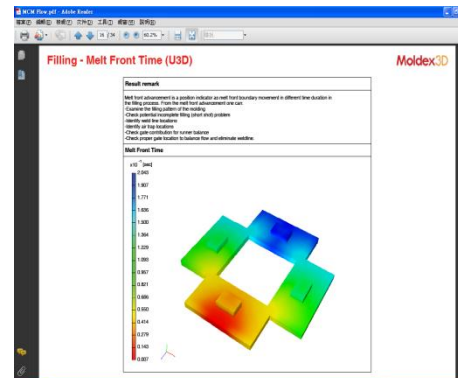
Mobile phone	eDesign element	Computation time (hr)					Total
		Flow	Pack	Cool	Warp		
12Core	1,930K	0.77hr	0.45hr	0.05hr	0.16hr	1.43hr	
16Core	1,930K	0.55hr	0.31hr	0.04hr	0.1hr	1hr	
32Core	1,930K	0.35hr	0.15hr	0.02hr	0.15hr	0.67hr	
12Core	2,780K	3hr	0.73hr	0.18hr	0.17hr	4.08hr	
16Core	2,780K	2.2hr	0.52hr	0.05hr	0.15hr	2.92hr	
32Core	2,780K	1.5hr	0.29hr	0.03hr	0.17hr	2hr	



A Windows Cluster of 8 PC, each with 1 CPU: Intel Core i7, 4core, 3.4GHz, RAM: 16GB; HD: 500GB

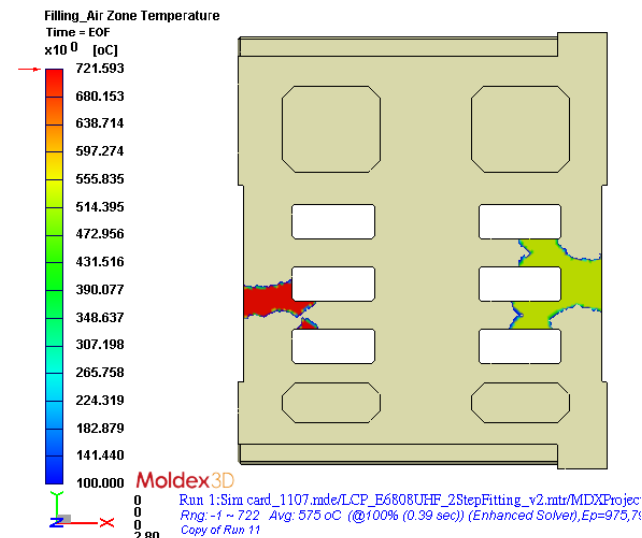
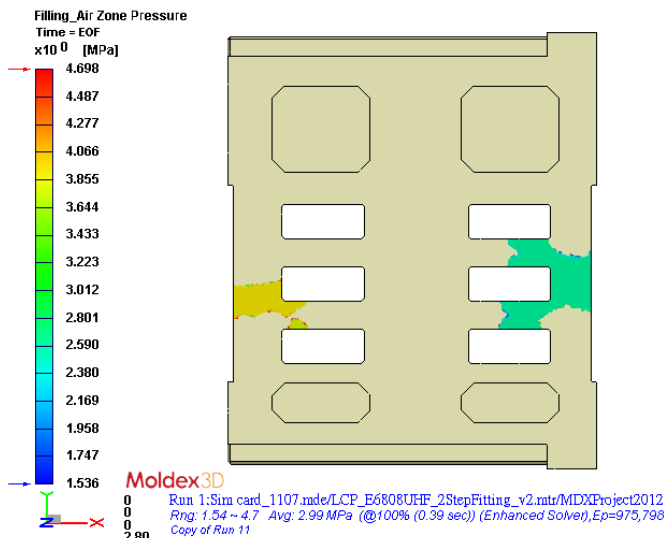
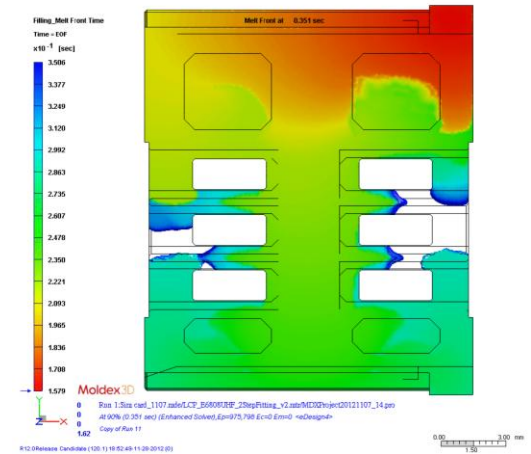
提供完整的辅助文件与沟通工具

- > 3D PDF 报告生成
- > 分析与结果与线上帮助文件整合
- > 免费的结果分享工具Viewer，支援各类分析



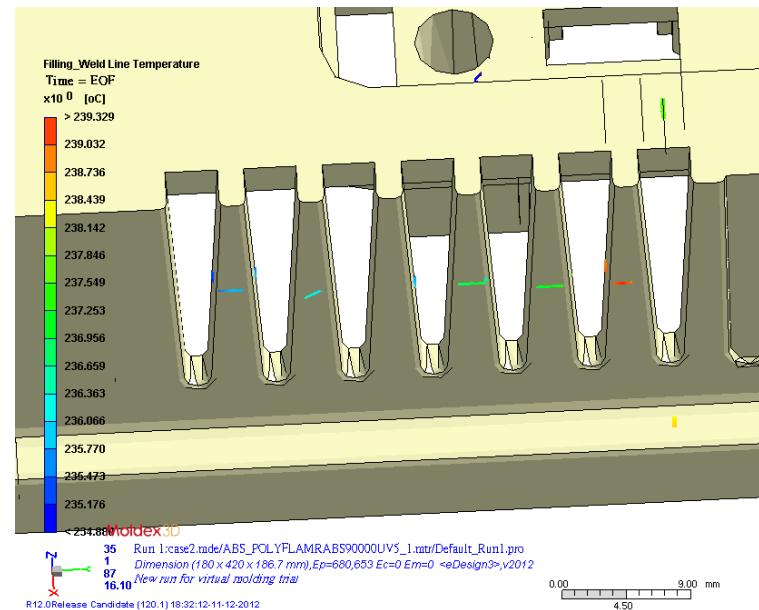
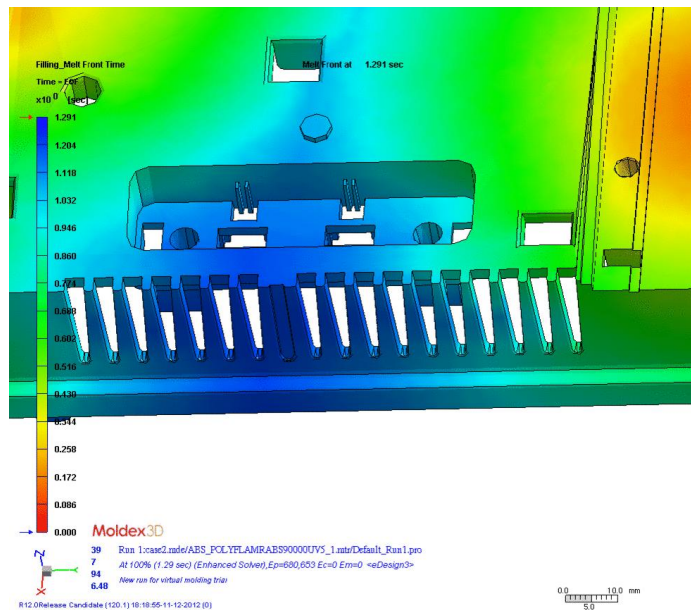
Air Temperature and Pressure Distribution for Venting Analysis

- > Predict temperature and pressure distribution of trapped air
- > Trapped air pressure will affect melt filling pattern
- > **Benefit**
 - Understand trapped air caused by the rising temperature. High trapped air temperature may induce burn mark defect



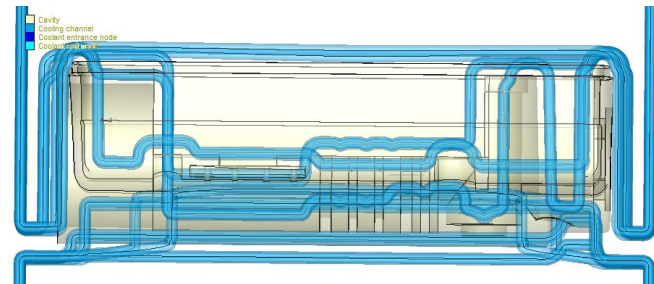
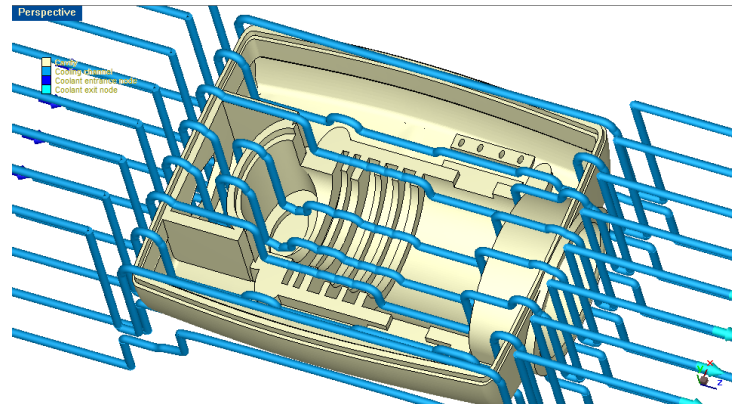
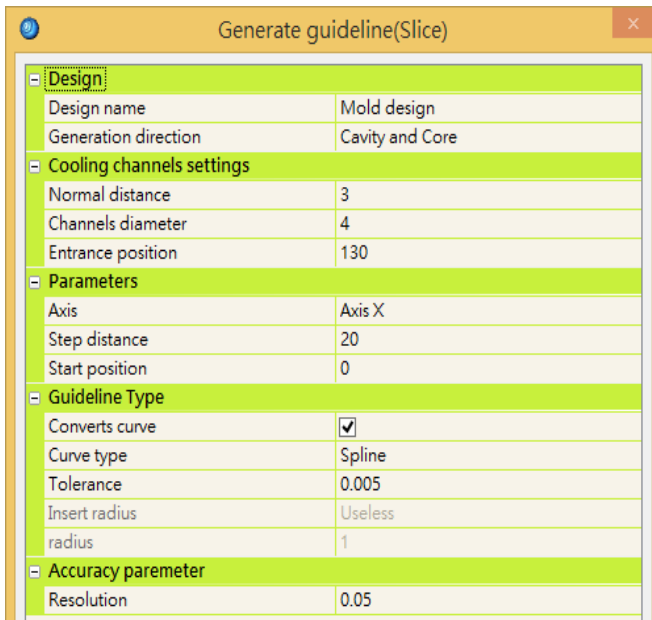
Weld Line Welding Temperature

- > Display welding temperature of each weld lines
 - The weld line is less obvious and with better structural strength if its welding temperature is higher
- > **Benefit**
 - Identify whether weld line causes appearance defects
 - Identify the structural strength of the weld line region



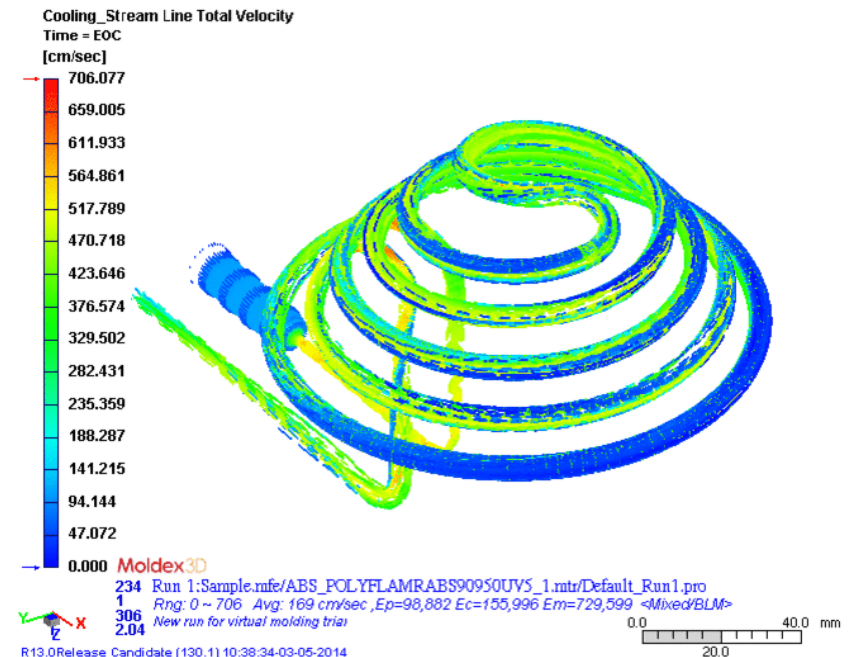
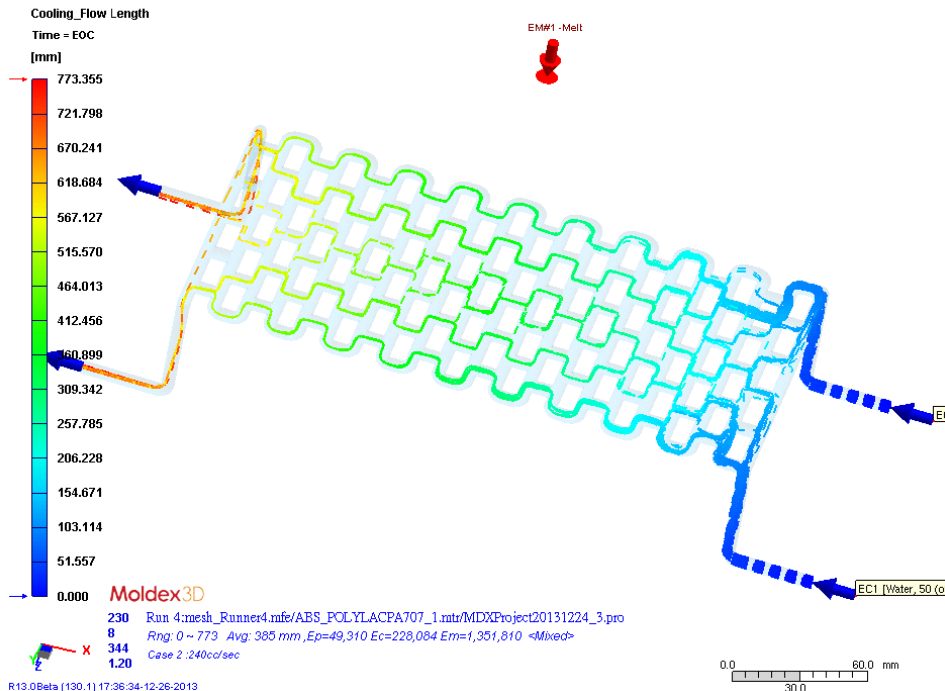
Cooling Channel Designer

- > Provides tools to arrange the cooling channel layout with the part surface
- > Options to define channel working axis, distance to part surface, coolant entrance location....etc.



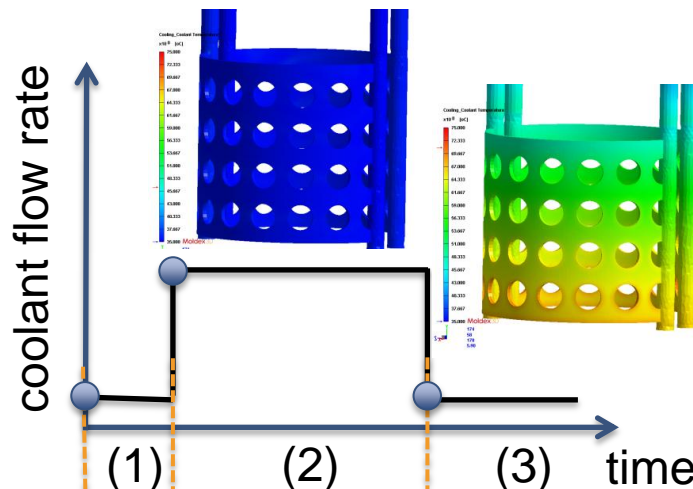
Multiple Coolant Inlet/Outlet Design Simulation

- > Supports the cooling channel analysis of complex cooling design, including multi-inlet and multi-outlet design
- > **Benefit**
 - For any complex cooling system design, **coolant streamline and flow field** can be analyzed and visualized in cooling channels.



Flow Rate Variation Control with Time

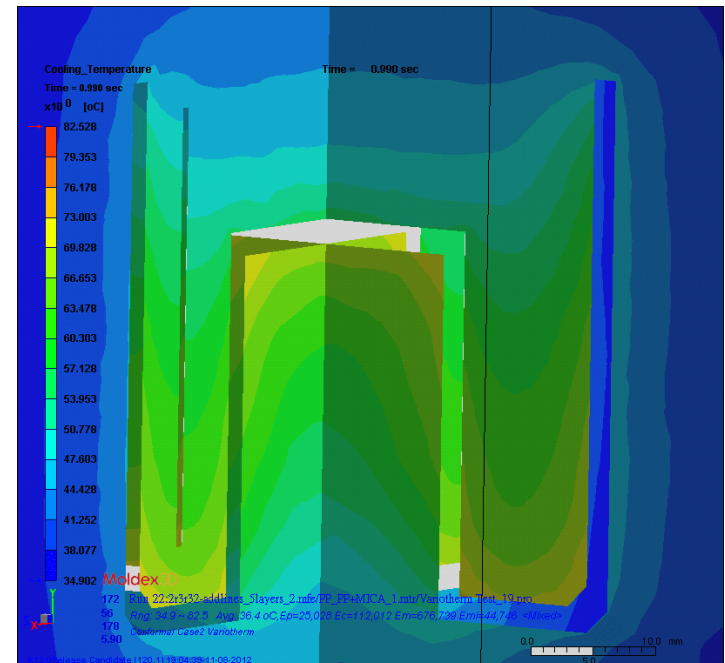
- Support to specify the variation of flow rate in cooling channels
- Mold base temperature distribution would be influenced by coolant flow rate variation
- **Benefit**
 - Support wider range of transient cooling design



(1) In filling stage, mold temperature increases

(2) At high flow rate, coolant has low temperature

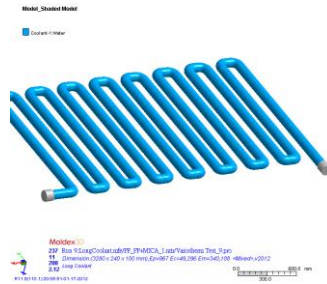
(3) At low flow rate, coolant has high temperature



Time-Dependent Profile for Cooling Channel (Heat & Cool)

Cooling channel

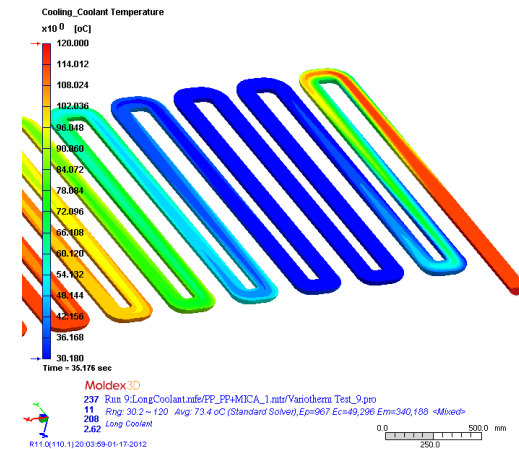
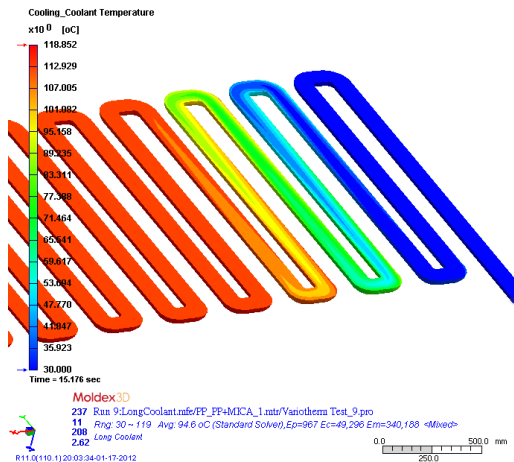
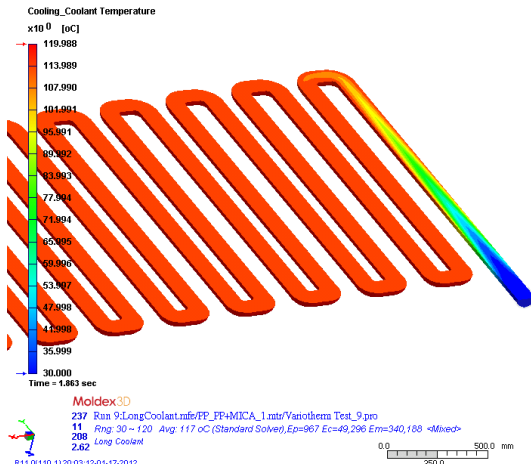
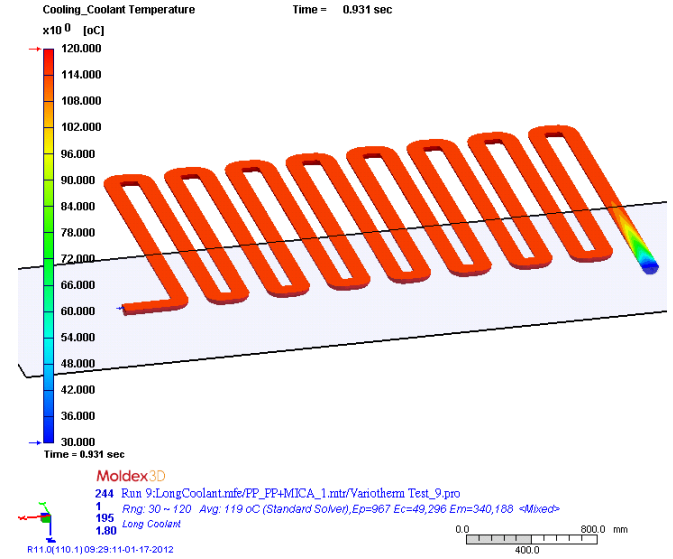
Channel ID	Control point	Time (sec)	T (oC)	Q (cm ³ /sec)	Coolant	D (mm)	Re
EC1 (Group 1)	2	0	120	2000	Water	100	87438.3
	1-1	1	30	2000	Water	100	31651.2
	1-2	30	120	2000	Water	100	87438.3



1. Cold Water

2. Cold Water

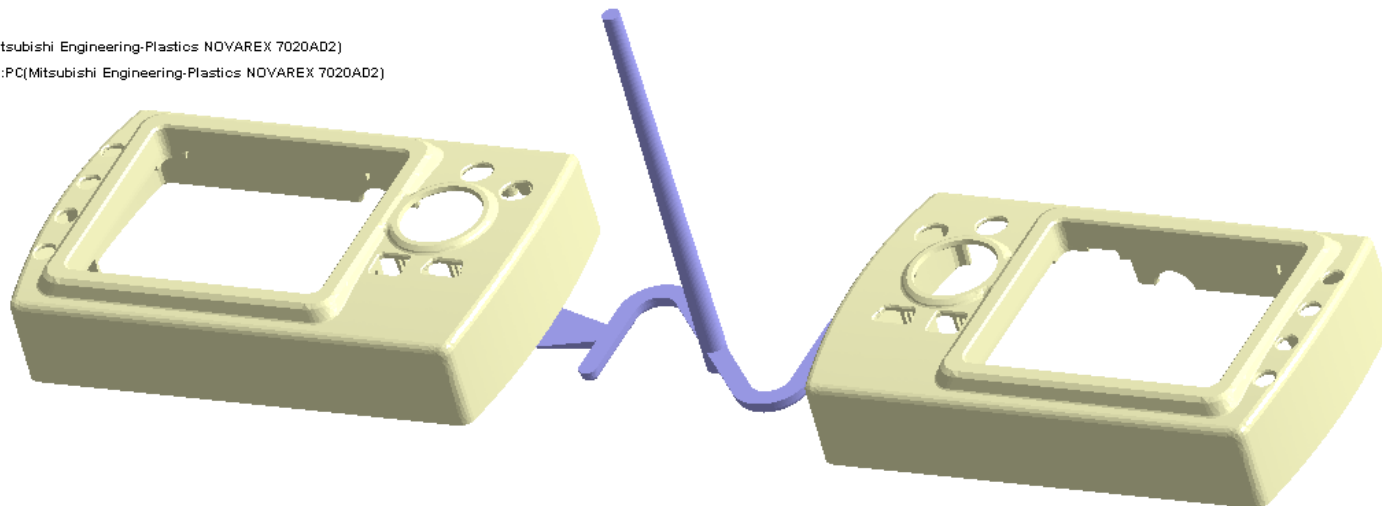
3. Hot Water



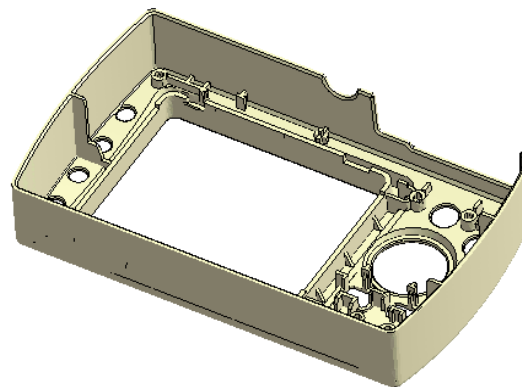
运用冷却设计提升生产效率与产品质量

Model_Shaded Model

■ Part-1:PC(Mitsubishi Engineering-Plastics NOVAREX 7020AD2)
■ Cold Runner:PC(Mitsubishi Engineering-Plastics NOVAREX 7020AD2)

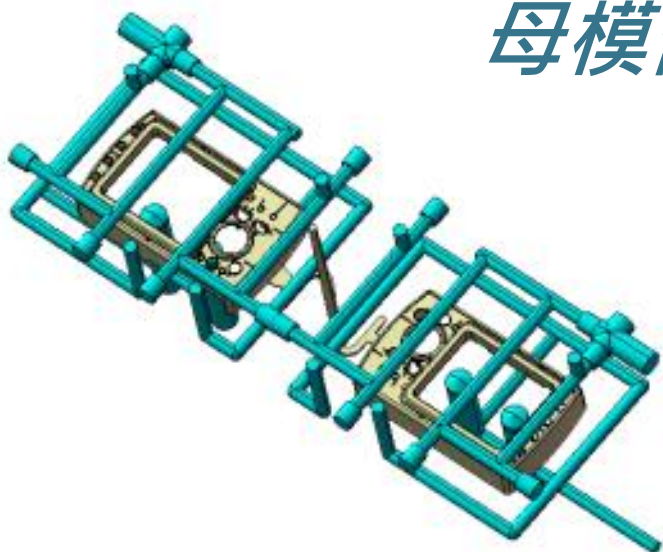


- 长度 : 270mm
- 高度 : 21.5mm
- 宽度 : 60mm
- 厚度 : 1.2mm

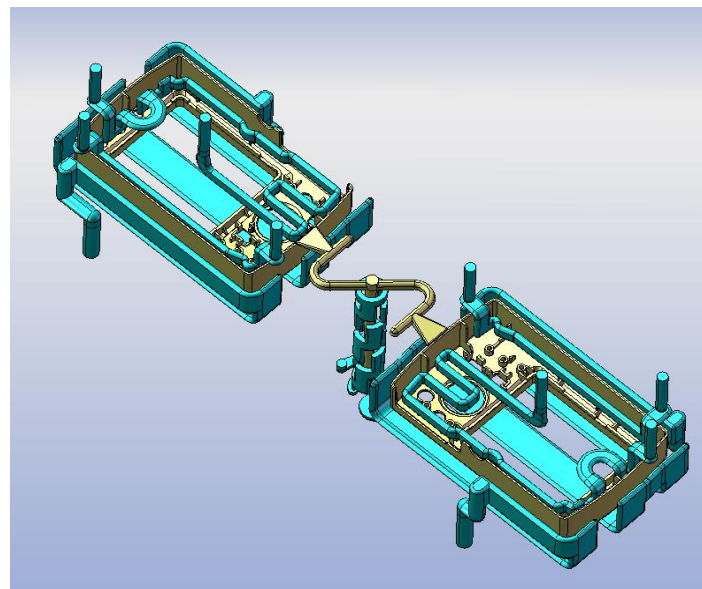
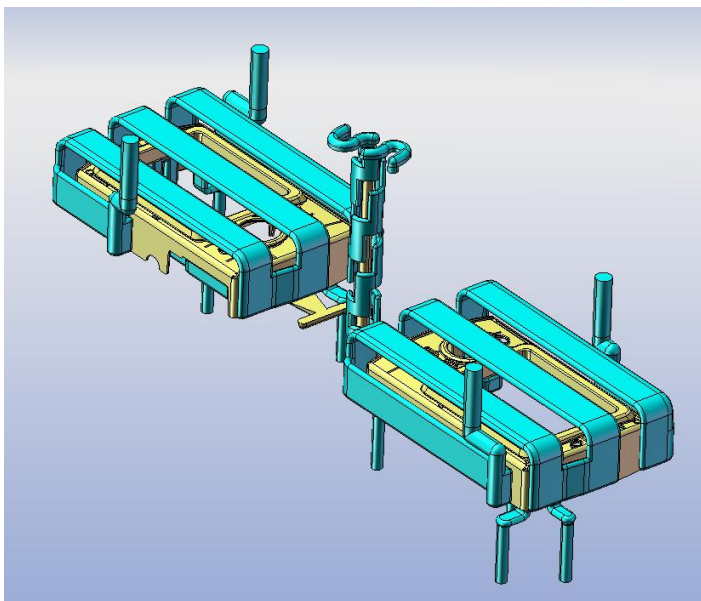
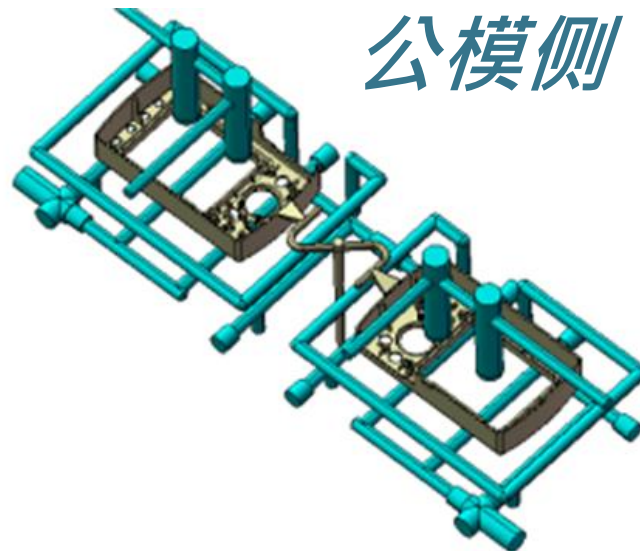


冷却设计是成型的关键

母模侧



公模侧

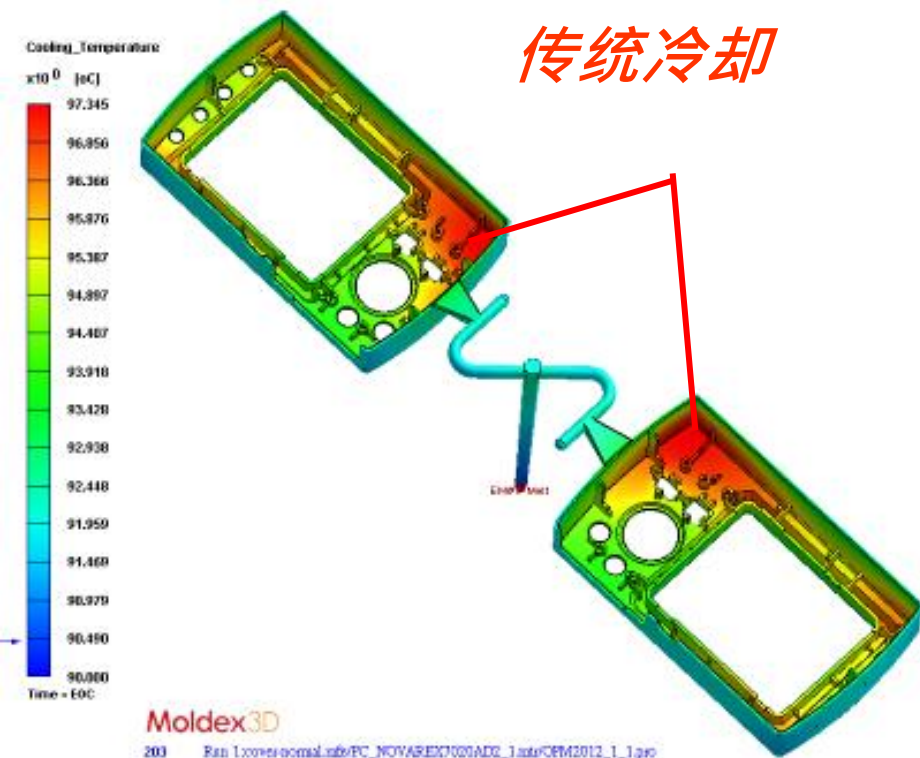


验证冷却设计的效果

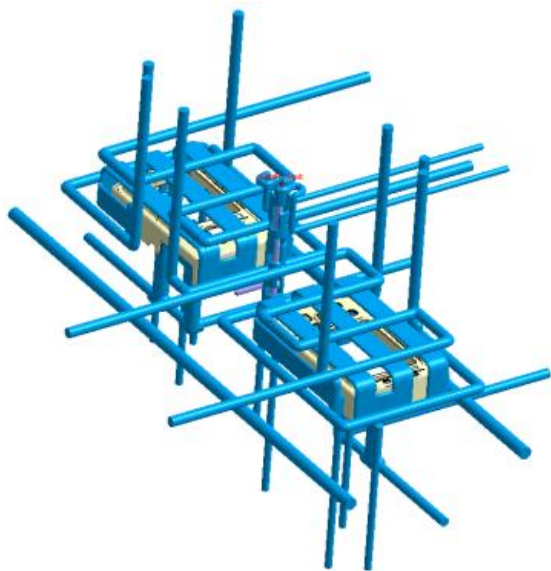
温度显示范围: 90~97 °C

传统冷却

随形冷却



鱼与熊掌兼得：同时提升质量与产量



随形冷却方式

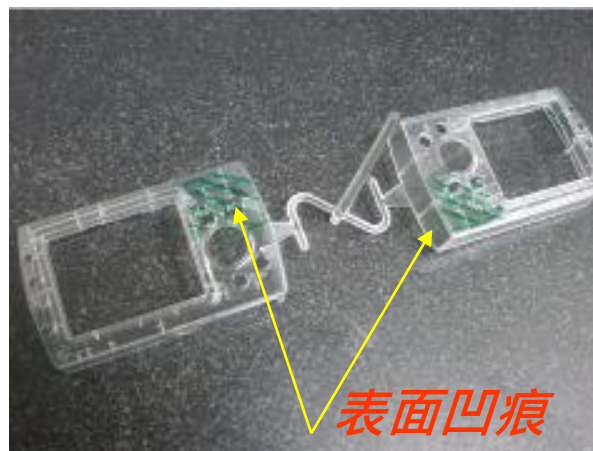
冷却时间: 9s
成型周期: 21s

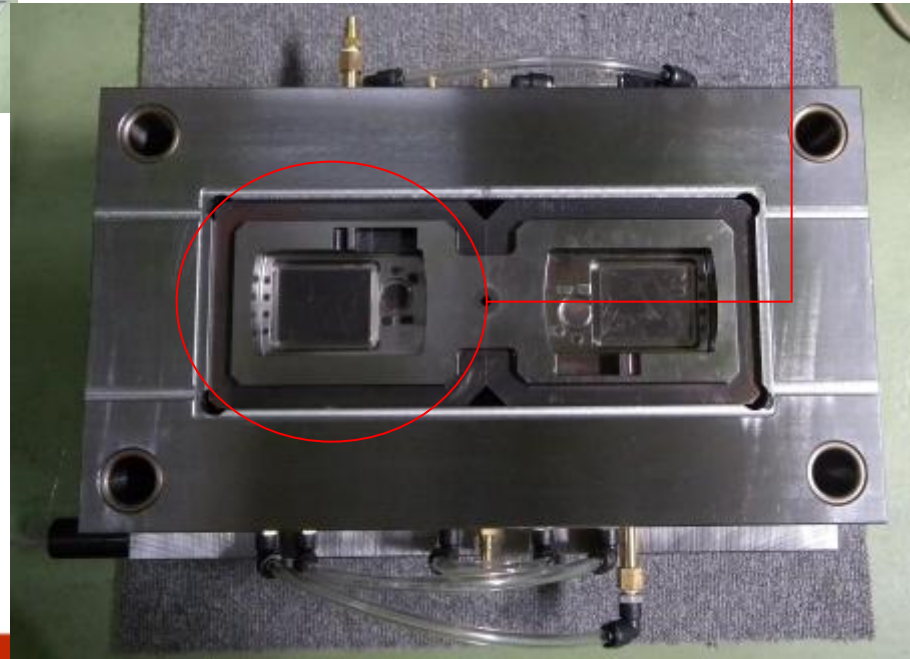
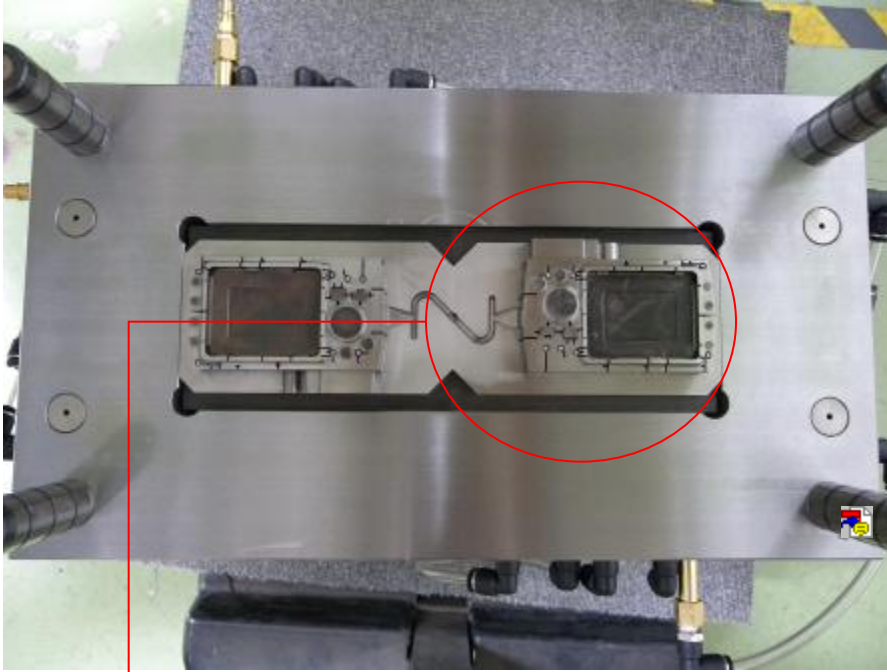


无凹痕连续生产

传统冷却方式

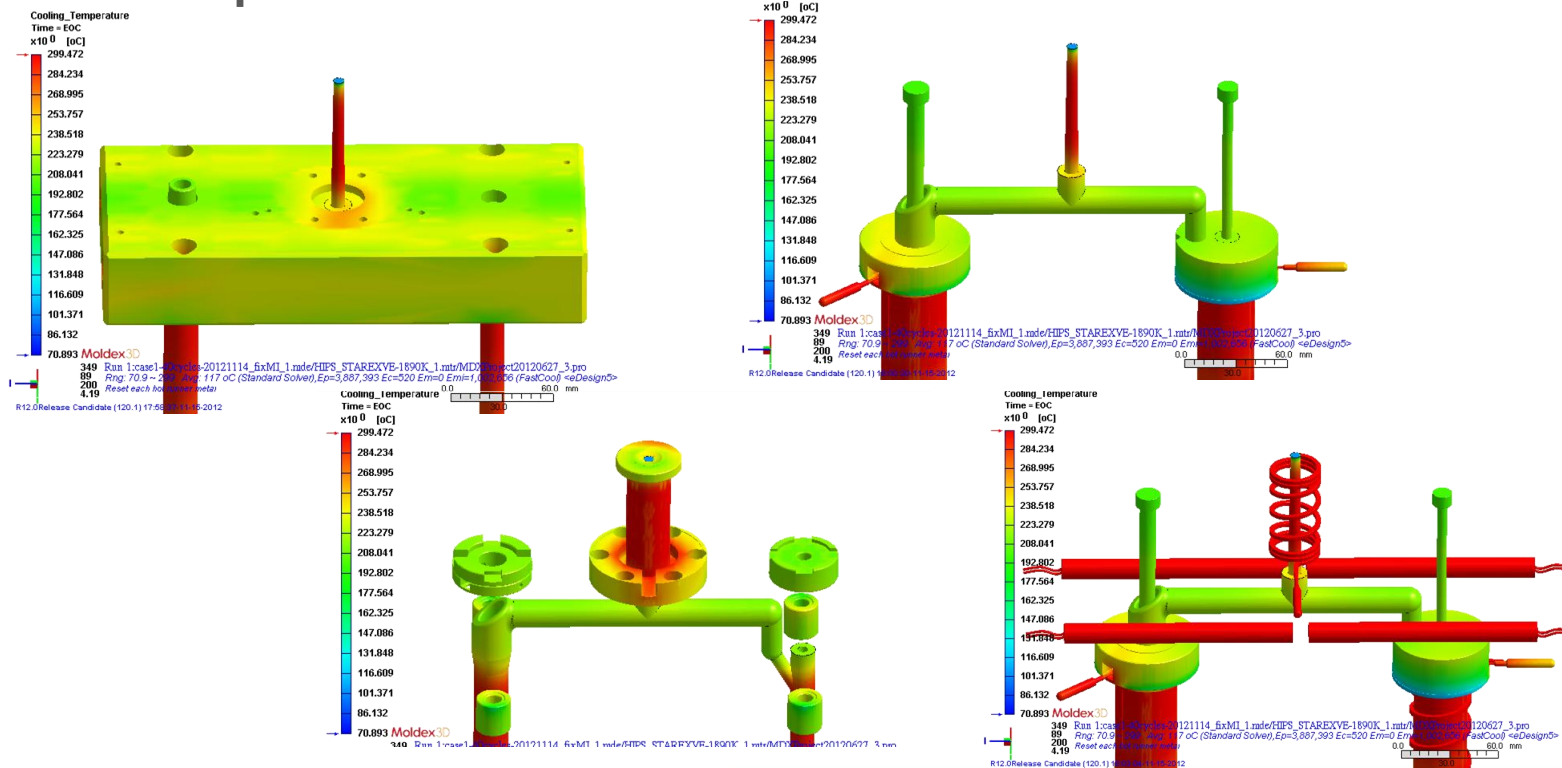
冷却时间: 13s
成型周期: 25s





Hot Runner Component Temperature Display

- > Temperature distribution display of each hot runner metal and heating rod components
- > Tool to switch on/off of each hot runner metal component
- > **Benefit**
 - Easier to visualize the temperature distribution of hot runner component

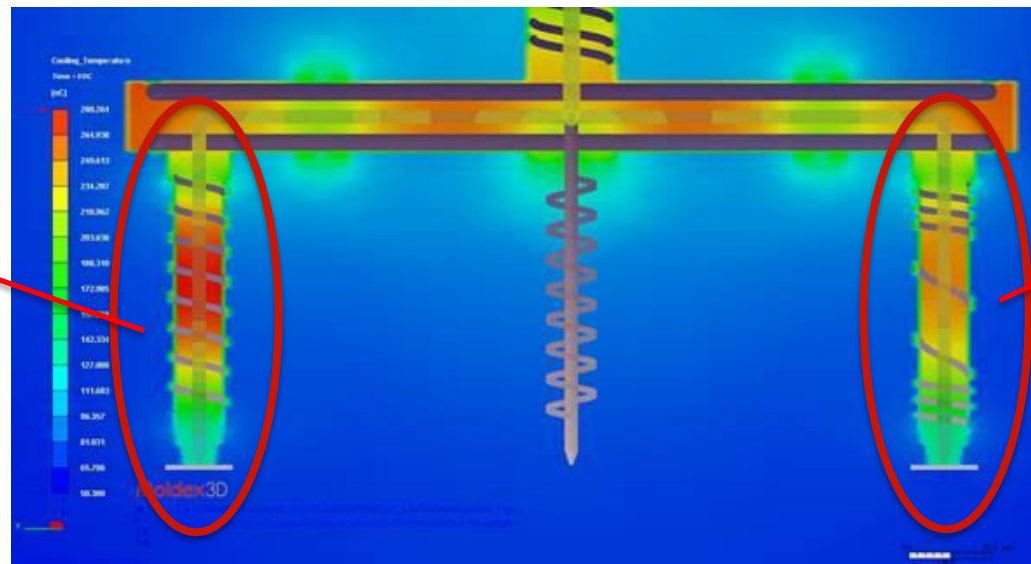


AHR: Heating Rod/Coil Design Verification

- > A fast analysis tool to verify the heating rod/coil design
- > Simulates the temperature distribution inside hot runner system by steady state approach
- > **Benefit**
 - Based on a new method, the temperature calculation efficiency in hot runner system speeds up 100 times.
 - Verify if the heating rod and coil designs function the heating properly in the hot runner system during the design stage.

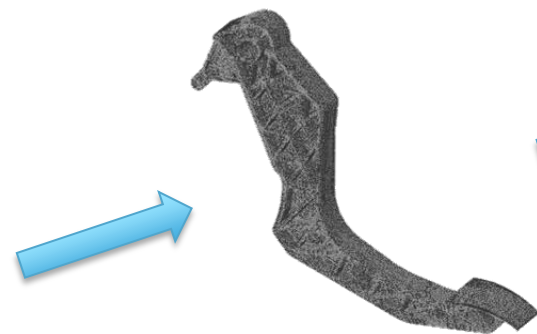
200W heating coil with uniform pitch

200W heating coil with variable pitch

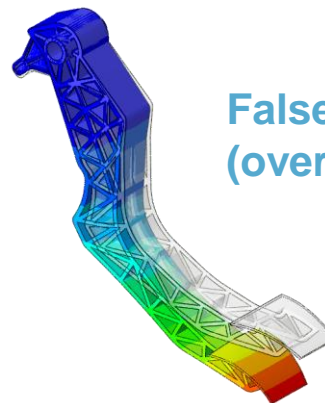


实现‘以塑代钢’的轻量化需求

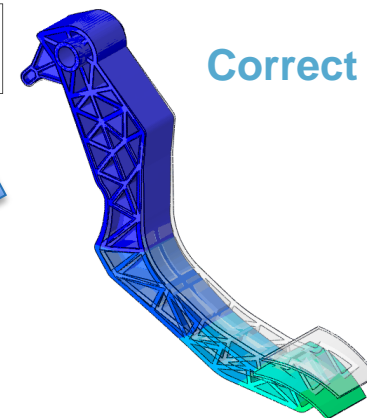
均质材料假设



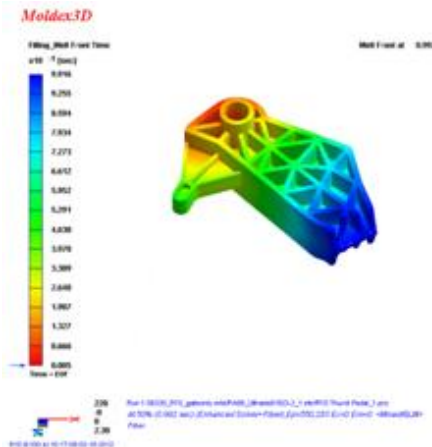
False deformation (over-estimated)



Correct deformation

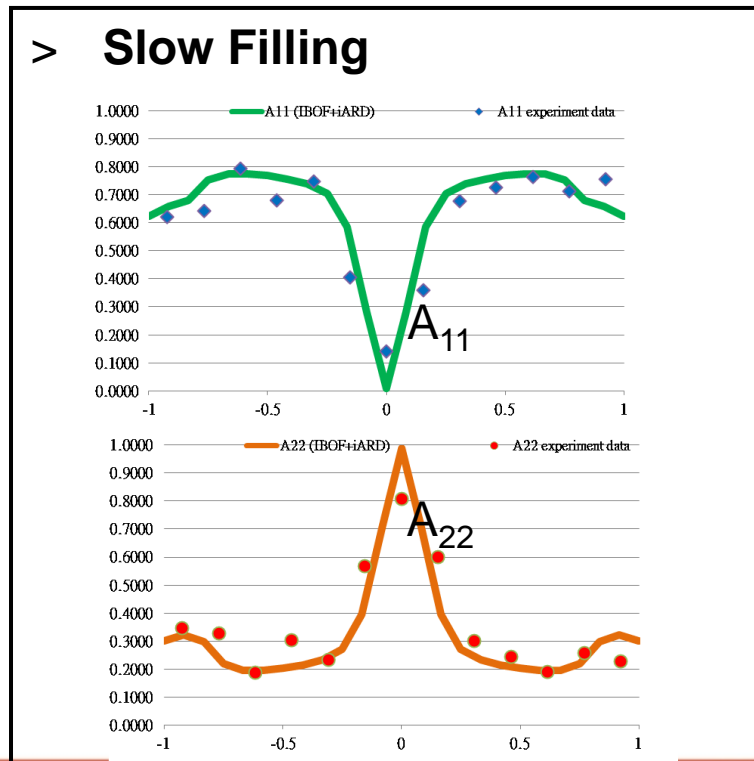
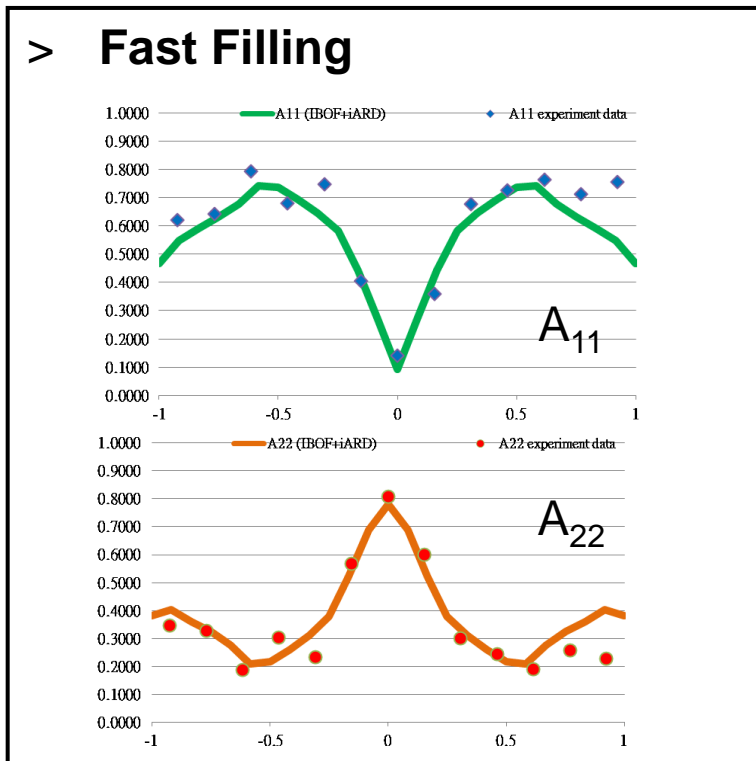


考虑纤维排向的非等向性
真实材料性质

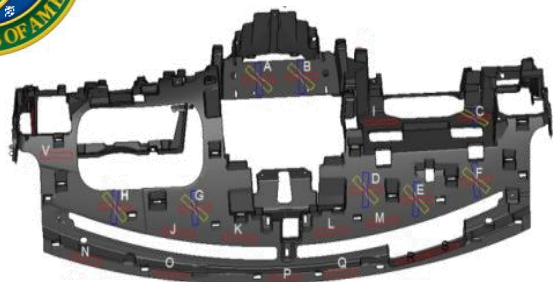


适用于短纤与长纤排向预测的新专利技术

- > 提供更正确的纤维排向预测，同时是用于长纤维与短纤维
- > 美国专利8,571,828号
- > 2013 SPE Automotive Composites Conference & Exhibition最佳技术论文



美国能源部先进汽车减重计画



LCFP Instrument Panel

•模拟分析



- Model development and integration
- Prediction and validation
- New model implementation

•量产实施



- System specification
- Weight and cost saving analysis
- Technology implementation
- Demonstration to production

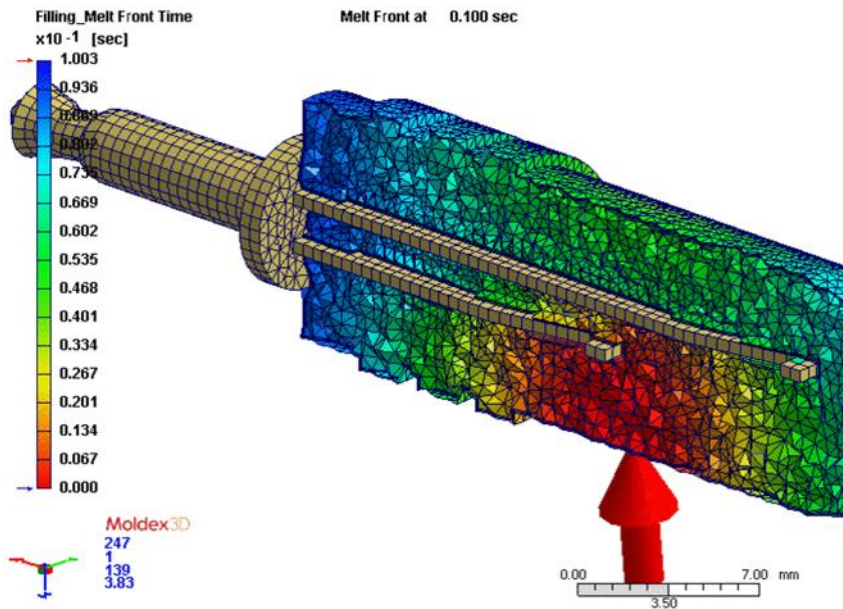
•实验验证



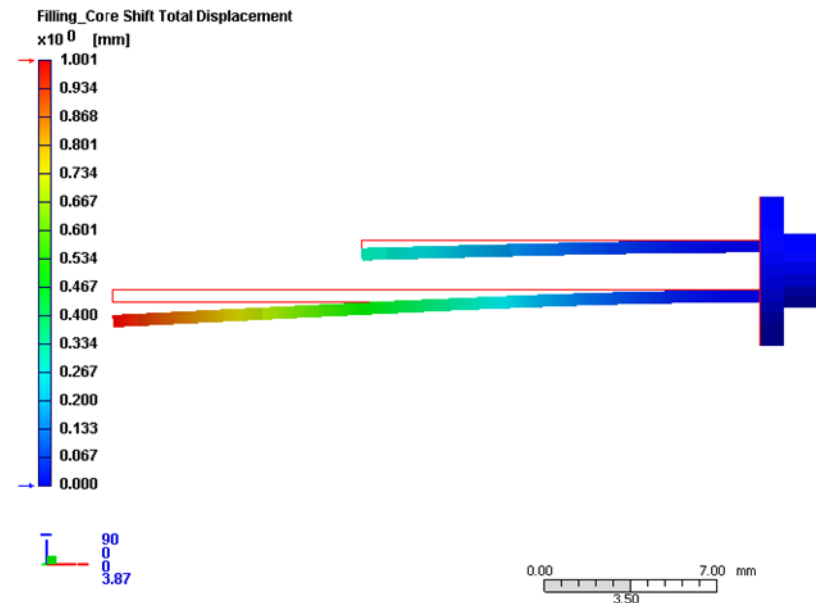
- Carbon fiber orientation distribution
- Carbon fiber length distribution
- Material preparation
- Molding

Application Real Cases: Earphone Jack

Core deflection during filling stage



In 2-Way FSI core deflection simulation, the cavity mesh will be deformed along with the deflected core



Final core shift result at EOF

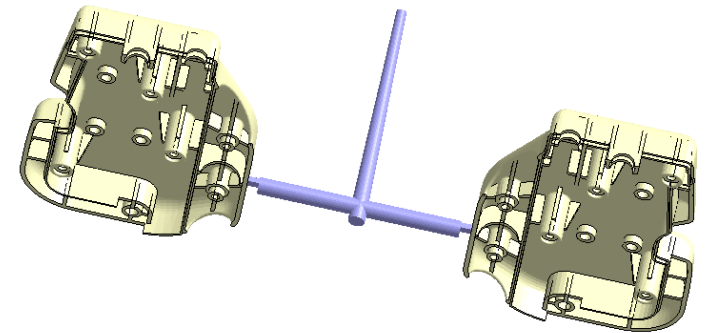
提升Moldex3D与ABAQUS的整合效能

> Benefit

- Take the complete model anisotropic property into account for ABAQUS stress analysis
- Save a lot of CPU time and memory usage when running stress analysis in ABAQUS
- That makes the full model analysis in ABAQUS becomes feasible

Model_Shaded Model

Part-1:ABS(A, Schulman POLYFLAM RABS 90000 UV5)
Cold Runner:ABS(A, Schulman POLYFLAM RABS 90000 UV5)



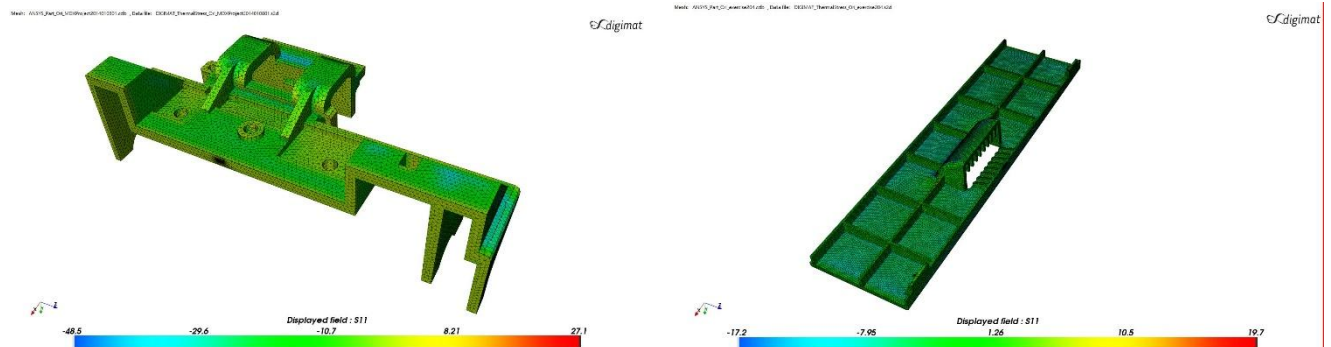
Moldex3D

Element number:776800
Part elements:763460
Part insert elements:13340

	Output CPU Time	Output File Size	ABAQUS Analysis CPU Time
Moldex3D R12.0	467 sec.	786MB	Solve 30mins (2G memory is enough)
Moldex3D R11.0 (Medium-Level reduction)	51,599 sec.	393MB	Solve 1 day ↑ (Huge memory needed)
Moldex3D R11.0 (No Material reduction)	458 sec.	405MB	Solve 1 day ↑ (Huge memory needed)

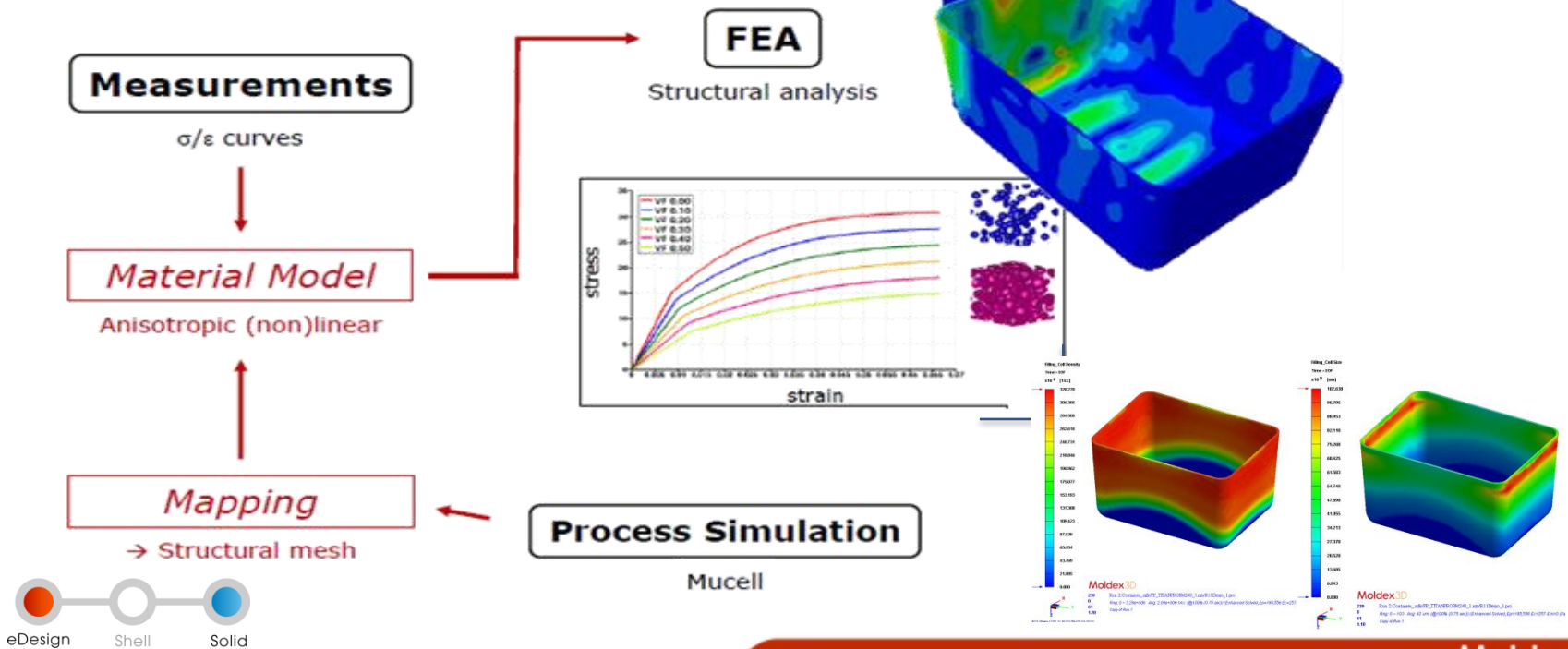
More Options of Digimat Output

- > To cover complete process-induced variation during the molding processes, the output items include
 - **Model fiber orientation**
 - **Weld line region data**
 - **Residual stress**
 - Digimat-MAP allows to map the residual stress data and account it as input of mechanical simulations.
 - **Temperature distribution at EOP and EOC**
 - Includes part and part insert object
 - Temperature before and after the cooling step could be used to perform a warpage analysis by Digimat.



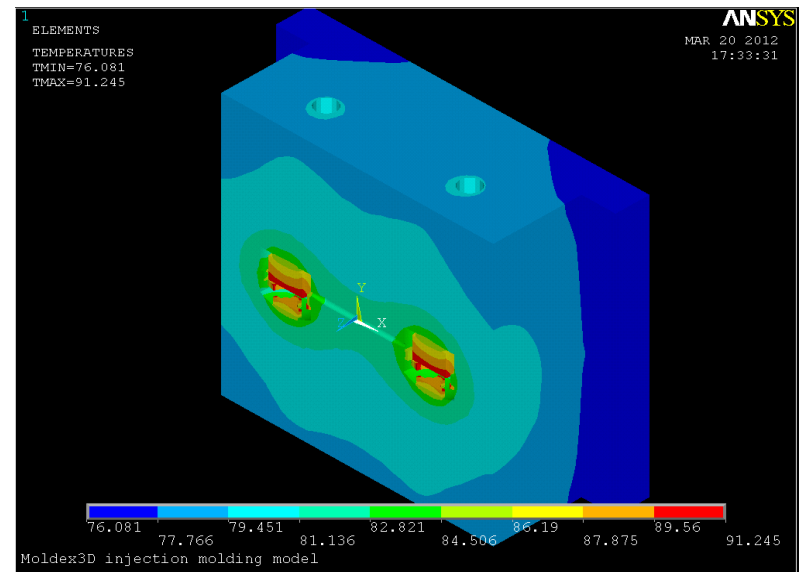
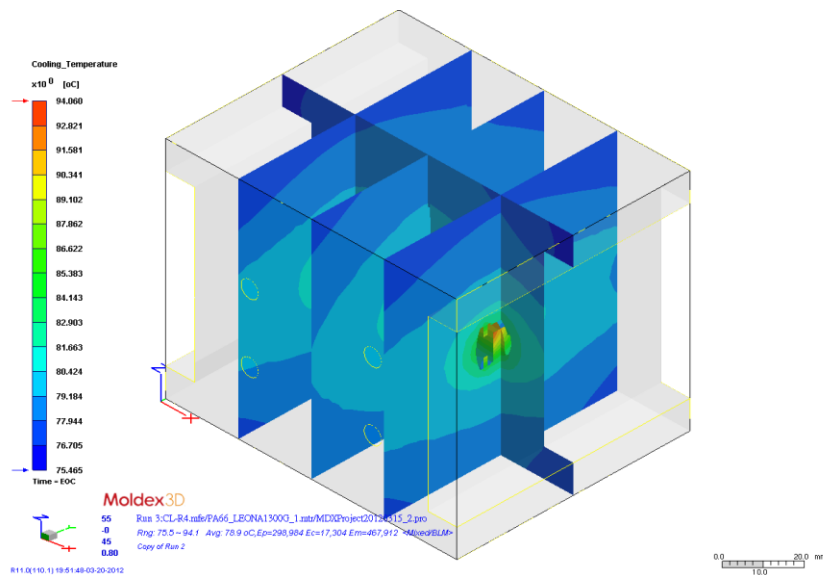
More Digimat options output in MuCell[®] Analysis

- > A new workflow for MuCell[®] part structural performance evaluation
- > Moldex3D outputs cell size and cell density data for Digimat
- > **Benefit**
 - Completely considers the cell size and cell density effects in MuCell[®] parts



Multiple Time Step Output of Mold Temperature

- > Available output option of mold temperature for multiple time steps
- > **Benefit**
 - Based on the mold temperature variation history, model deformation behavior can be caught more accurately in stress solver.

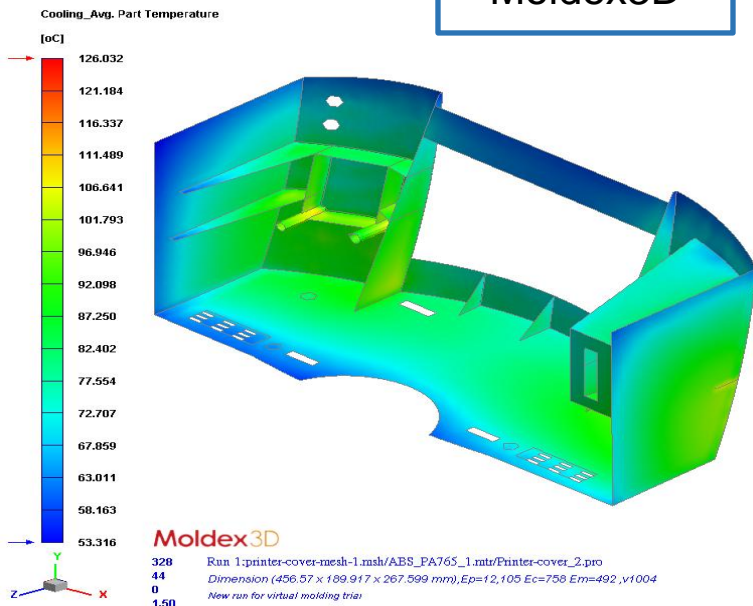


More Output Options to ABAQUS Shell Analysis

> Supports more output options in Shell FEA Interface for ABAQUS, including:

- Initial strain output
- Packing phase temperature output
- End of cooling temperature output

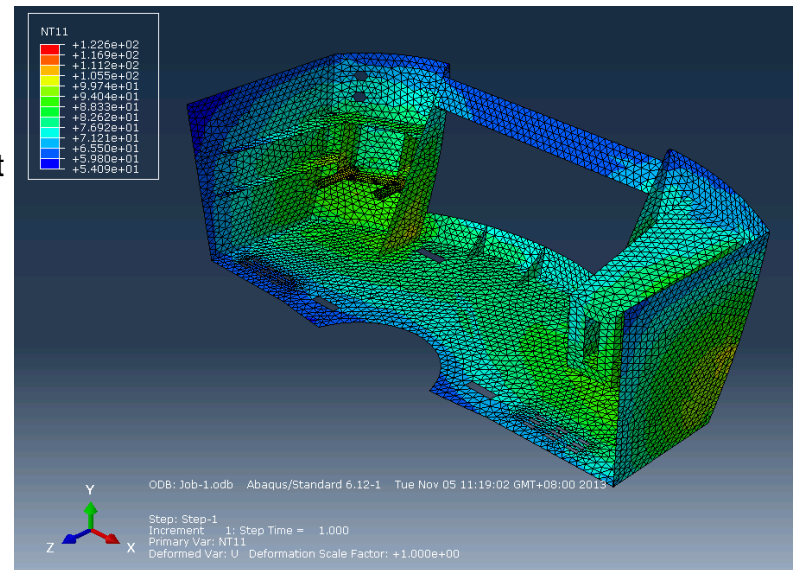
Moldex3D



End of cooling temperature output

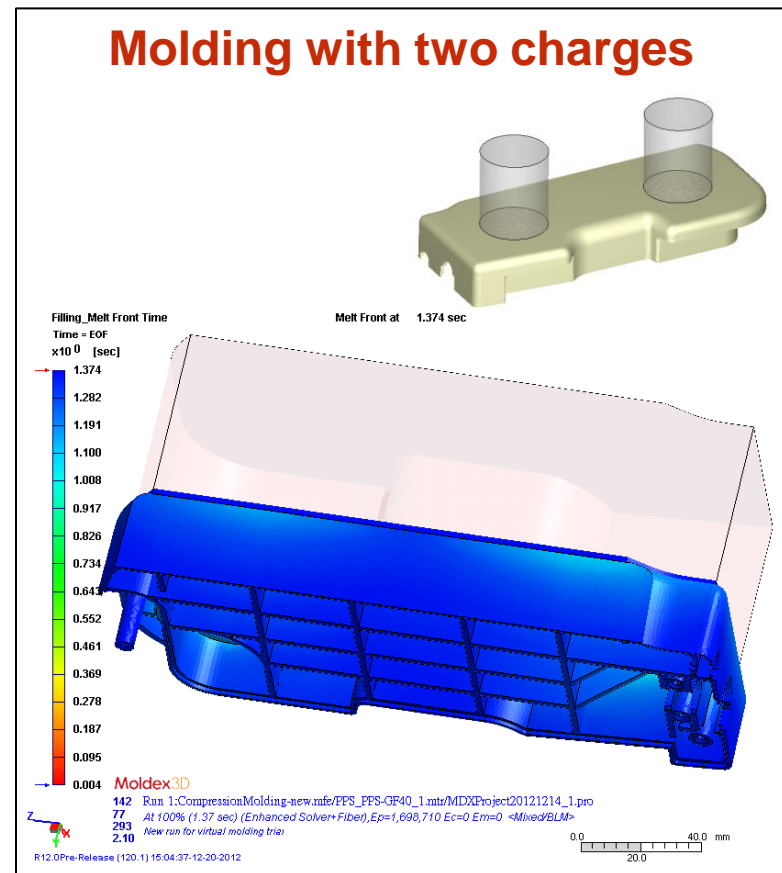
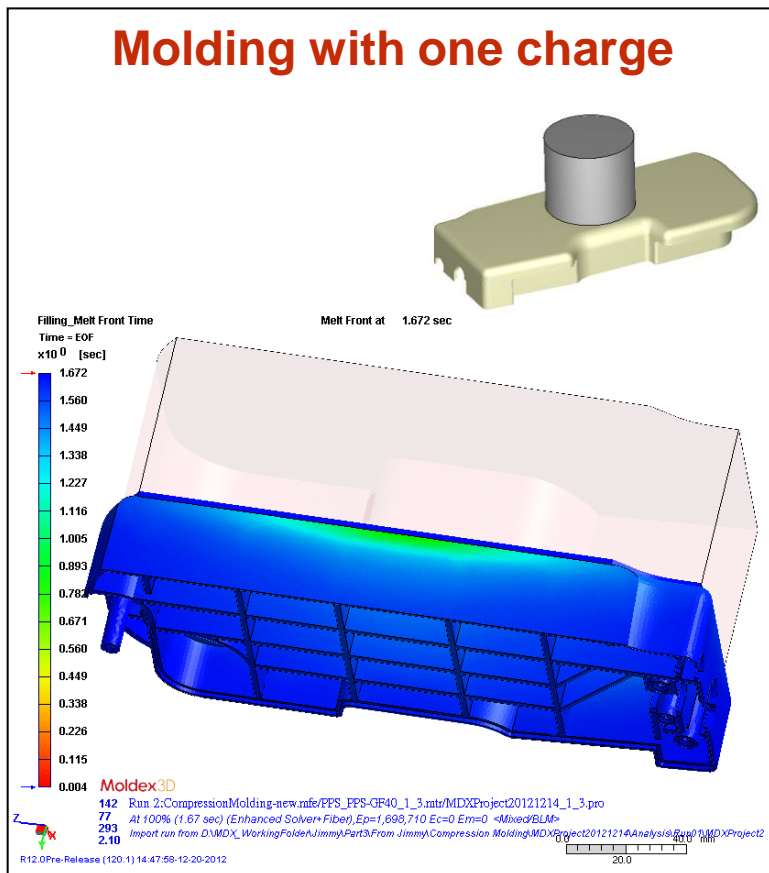


Abaqus



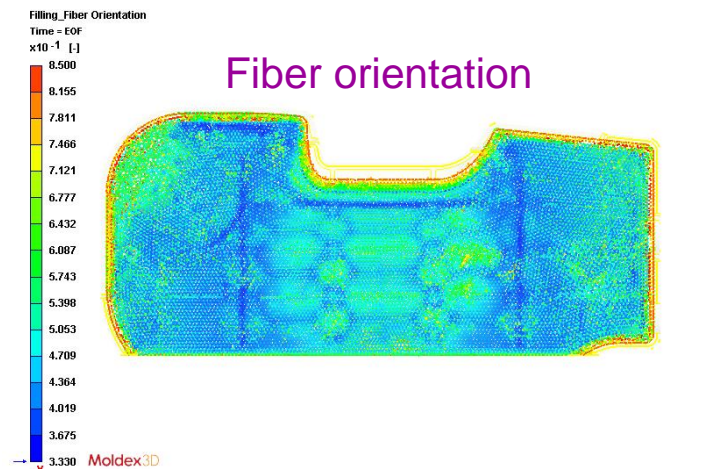
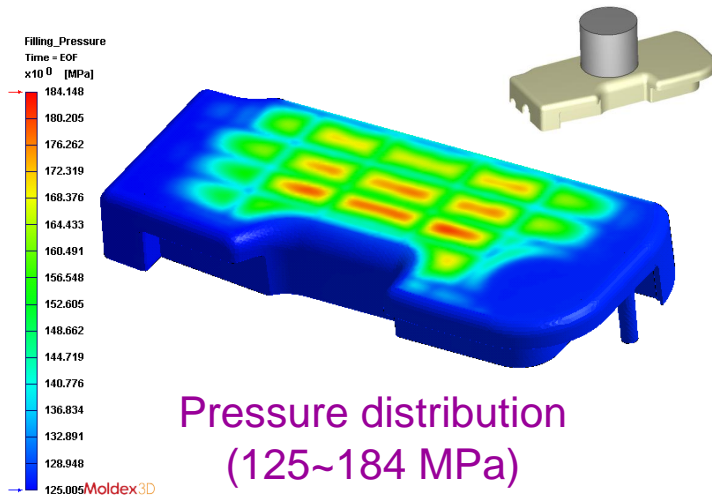
热压成型制程仿真模拟

- > Support arbitrary charge volume & shape setting
- > Support single or multiple charges

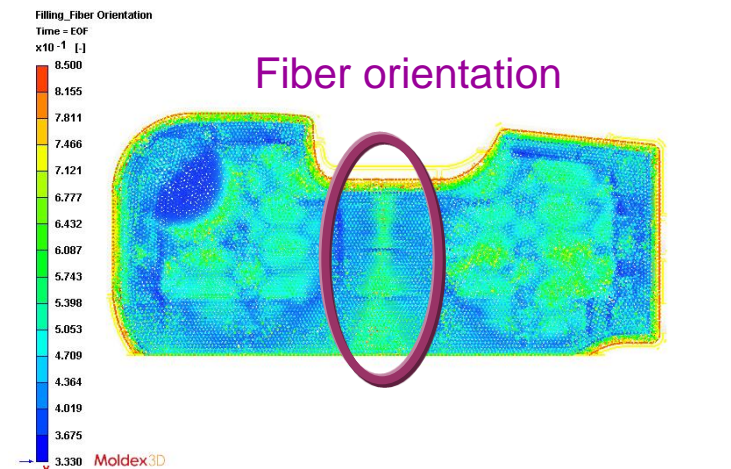
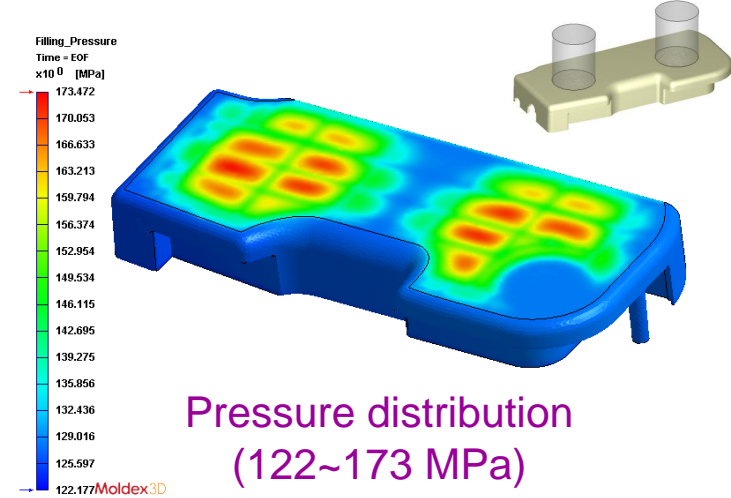


热压成型制程仿真模拟

Molding with one charge

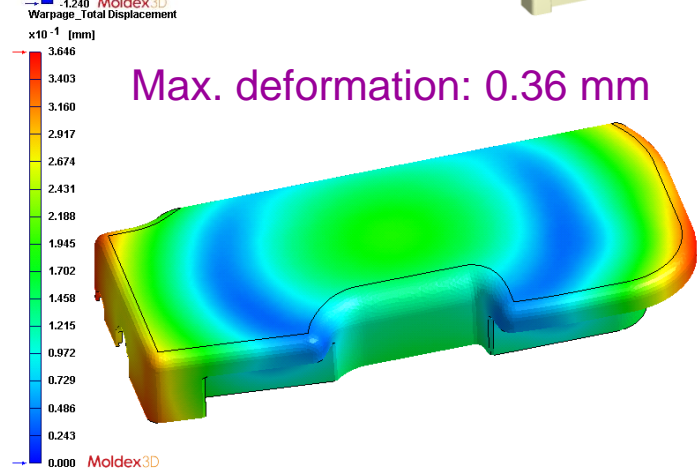
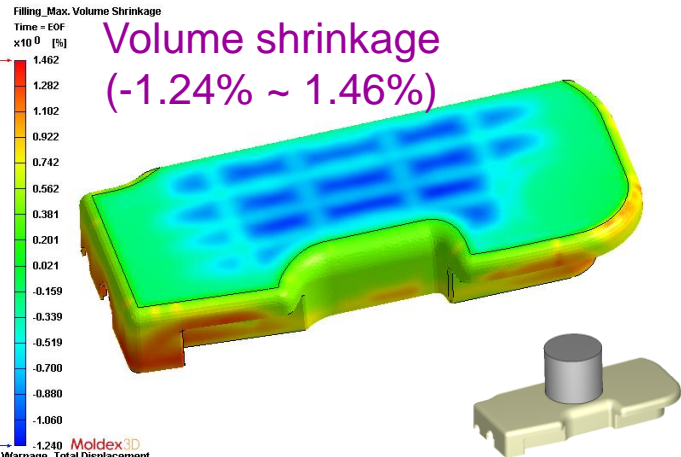


Molding with two charges



热压成型制程仿真模拟

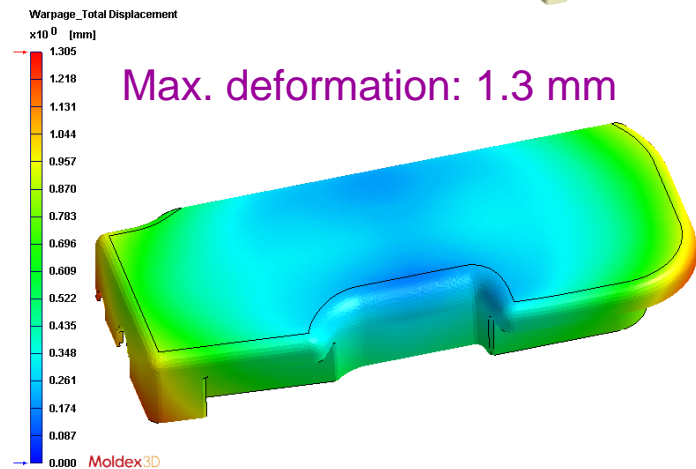
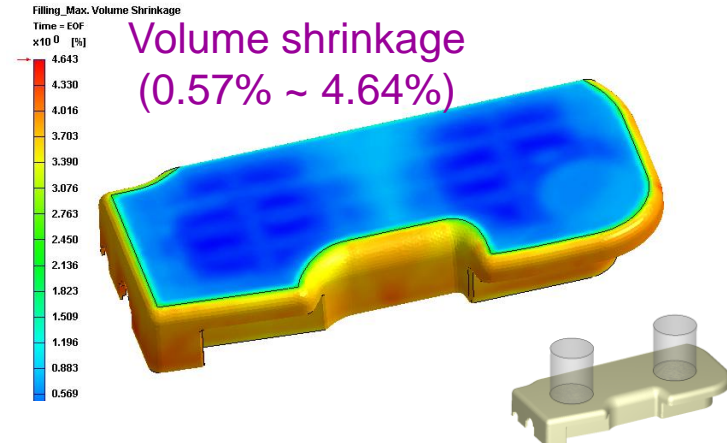
Molding with one charge



134 Run 2: CompressionMolding-new.mfe\FPS_FPS-QF40_1_3.mtr\MDXProject20121214_1_3.pro
285 Ring: 0 ~ 0.365 Avg: 0.0192 mm (Scale:0.00,Total:1.00),Ep=1,698,710 Ec=0 Em=0 <MixedBLM>
6 Import run from D:\MDX_WorkingFolder\Jimmy\Part3\From Jimmy\Compression_Molding\MDXProject20121214\Analysis\BLS\00.MDXProjec
2.00 New run for virtual molding trial

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Molding with two charges



134 Run 1: CompressionMolding-new.mfe\FPS_FPS-QF40_1.mtr\MDXProject20121214_1.pro
285 Ring: 0 ~ 1.31 Avg: 0.0725 mm (Scale:0.00,Total:1.00),Ep=1,698,710 Ec=0 Em=0 <MixedBLM>
6 Import run from D:\MDX_WorkingFolder\Jimmy\Part3\From Jimmy\Compression_Molding\MDXProject20121214\Analysis\BLS\00.MDXProjec
2.00 New run for virtual molding trial

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总结

- > **Moldex3D**真实三维实体模流分析技术兼具方便、易用、正确与高效计算的优点，并可与任何**CAD**软件集成，作为标准设计验证工具
- > **Moldex3D**支援各种先进制程，协助用户追求创新增值
- > **Moldex3D** 是全球最大的独立模流分析软件与技术服务提供商，拥有**240**人的专业团队，并且独家拥有全亚洲最先进、最完整的材料性质量测实验室，全方位支持客户的需求

真心真意共创未来

