

The MuCell Microcellular Foaming MuCell 微发泡注塑工艺

微发泡技术在汽车注塑件上的应用

Strategic Quality Improvement
策略性质量改善工艺
&
Cost Savings Technology
成本节省技术

Trexel, Inc.
www.trexel.com

Issues of Traditional Injection Molding 【传统注塑限制】

- High energy consumption 【高能耗】
- Production efficiency is not optimized 【生产效率难优化】
- Rising material cost 【材料费不断提升】
- Design For Manufacturing (DFM) implies constraints to design 【为制造而设计的准则、局限了设计自由性】

MuCell Injection Technology application

MuCell注塑技术的应用

1. MuCell Technology Introduction

MuCell 技术介绍

2. Phase 1: Cost Saving 节省成本

3. Phase 2: Design Freedom 设计更自由化

A microscopic image showing a dense field of cells, likely a tissue section, with various cell shapes and structures visible. The image is in shades of teal and light blue.

1、MuCell Technology Introduction (MuCell技术介绍)

MuCell Technology Status

MuCell技术的发展

Invented at Massachusetts Institute of Technology (M.I.T.), commercialized by **Trexel**. Over 70 patents filed in Asia, Europe and N. America 早期由麻省理工学院发明, 美国 **Trexel** 公司将技术全球商品化, 现在已拥有或申请超过70个专利权

Broad injection system supplier's support 世界主要注塑机支持:

ARBURG

NISSEI

Demag ergotech

MITSUBISHI
HEAVY INDUSTRIES, LTD.

TOSHIBA

ENGEL

MILACRON
Plastics Technologies Group

JSW

TOYO
MACHINERY & METAL

KRAUSSMAFFEI

DHC DongShin Hydraulics co

Broad material supplier's support 世界主要塑料供应商广支持:

Ticona
ENGINEERING POLYMERS

DUPONT

Bayer

AsahiKASEI
ENGINEERING PLASTICS

Rhodia

BASF
The Chemical Company

Honeywell

SUMITOMO CHEMICAL

IDEMITSU

MuCell Processes
REXEL INC.

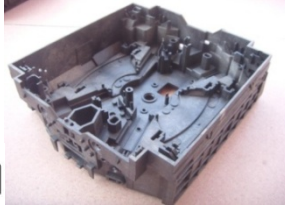
MuCell now in Many Applications

现今MuCell® 在各方面的应用

Business Equipment

商业设备

LEXMARK

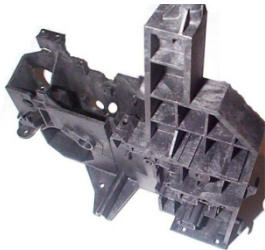


KYOCERA
mita

RICOH



hp
invent



Canon

EPSON

Automotive

汽车

Audi



PORSCHE



Ford

CHRYSLER

GM

NISSAN

HONDA

KIA



mazda

TOYOTA



Industrial & Electrical

工业/电子

CLIPSAL®



SAMSUNG

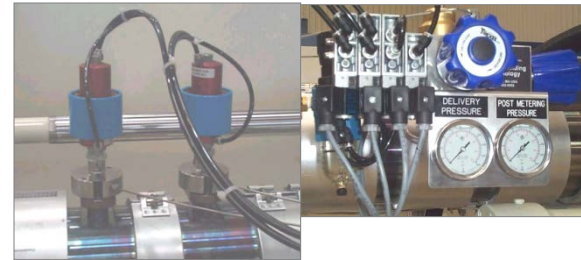


MuCell Processes
REXEL INC.

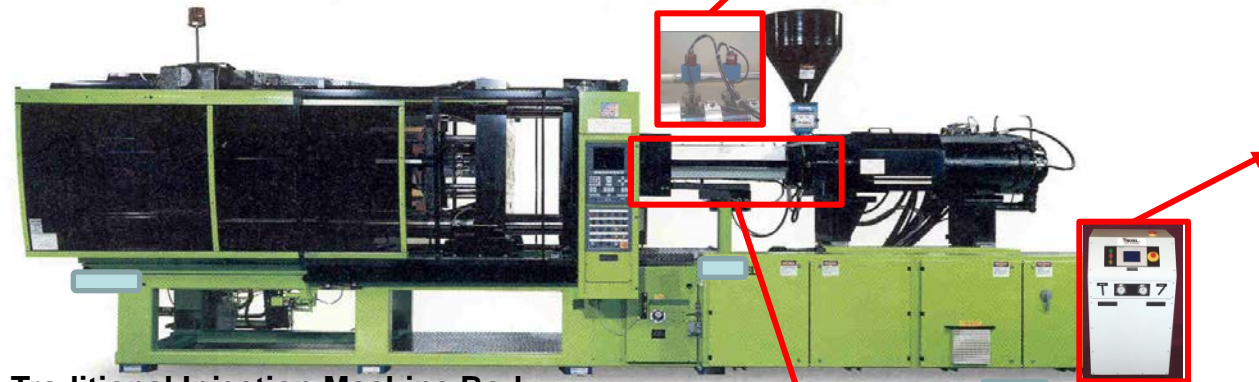
MuCell Equipment MuCell设备组成介绍

实施形式

- ① MuCell功能新机台
- ② 升级现有机台



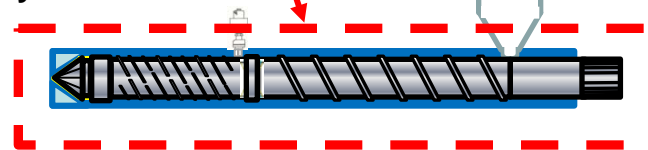
② Interface Kit
界面组件



Traditional Injection Machine Body
传统成形機本体



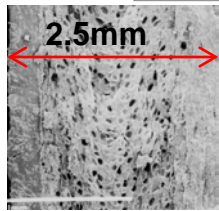
① Gas metering system
气体控制系统



③ Injection unit 射出单元

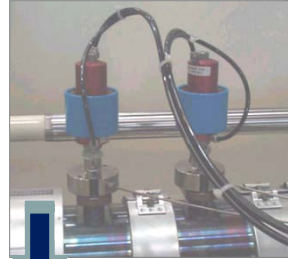
MuCell Process MuCell工艺介绍

Foamed part with
Microcellular structure
微发泡成形品



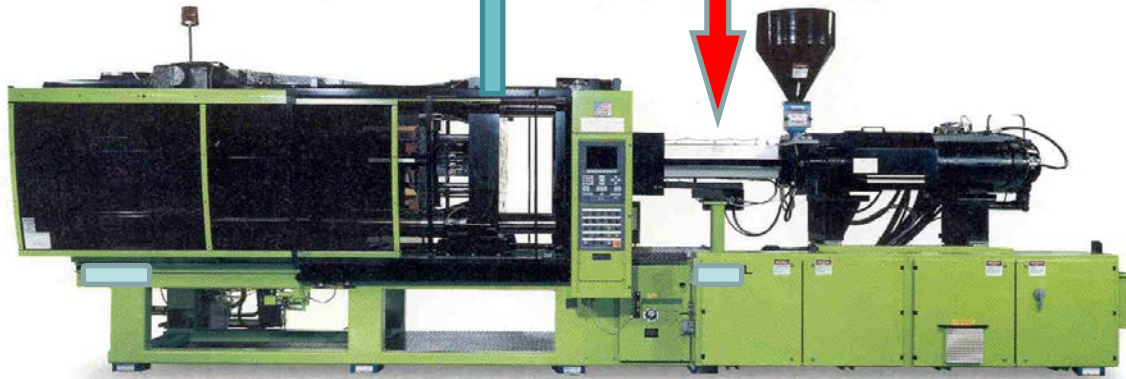
断面图

Interface Kit
界面组件



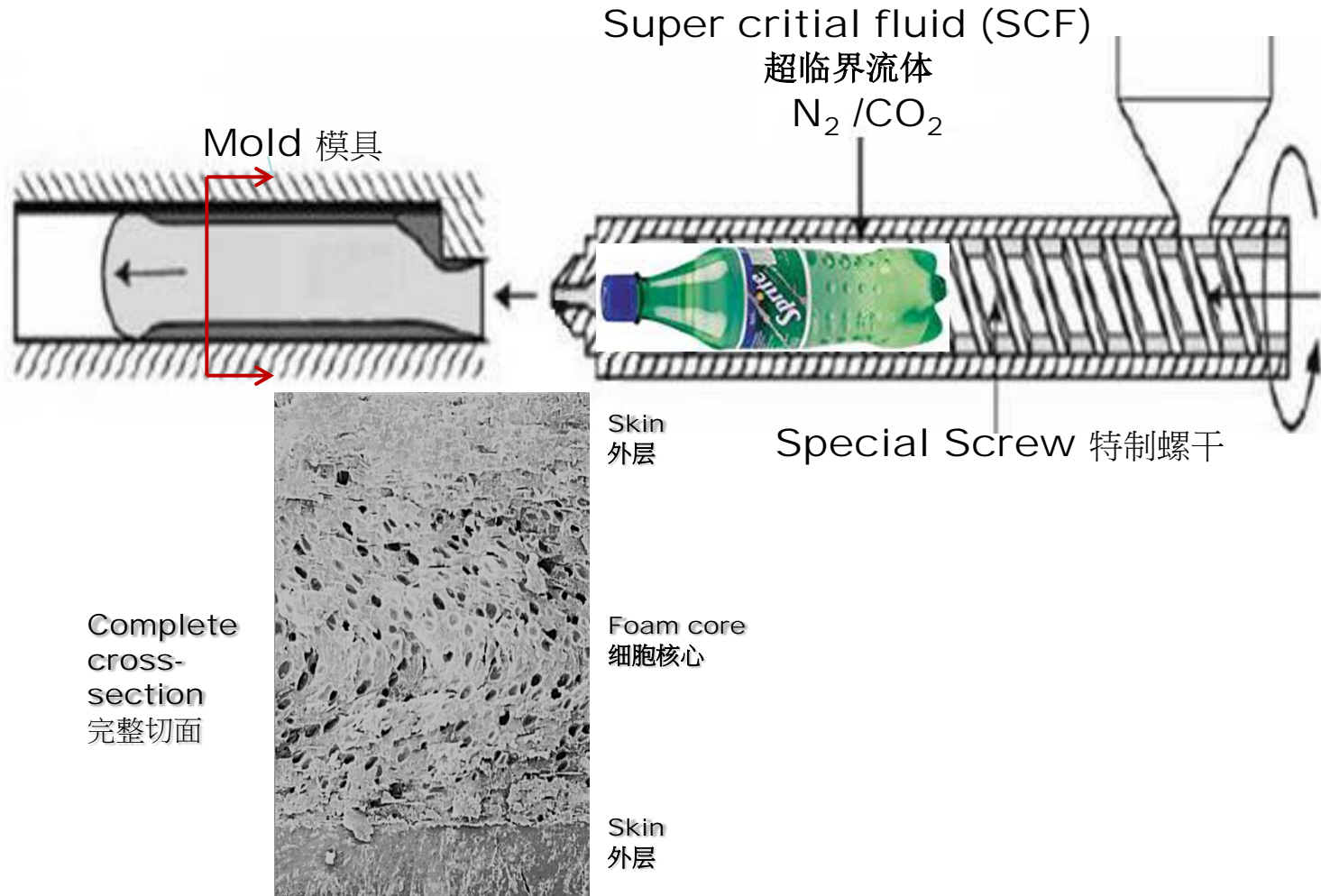
Super critical
fluid (SCF)
超临界流体

Gas supply
(N₂ or CO₂)



Gas metering
system
气体控制系统

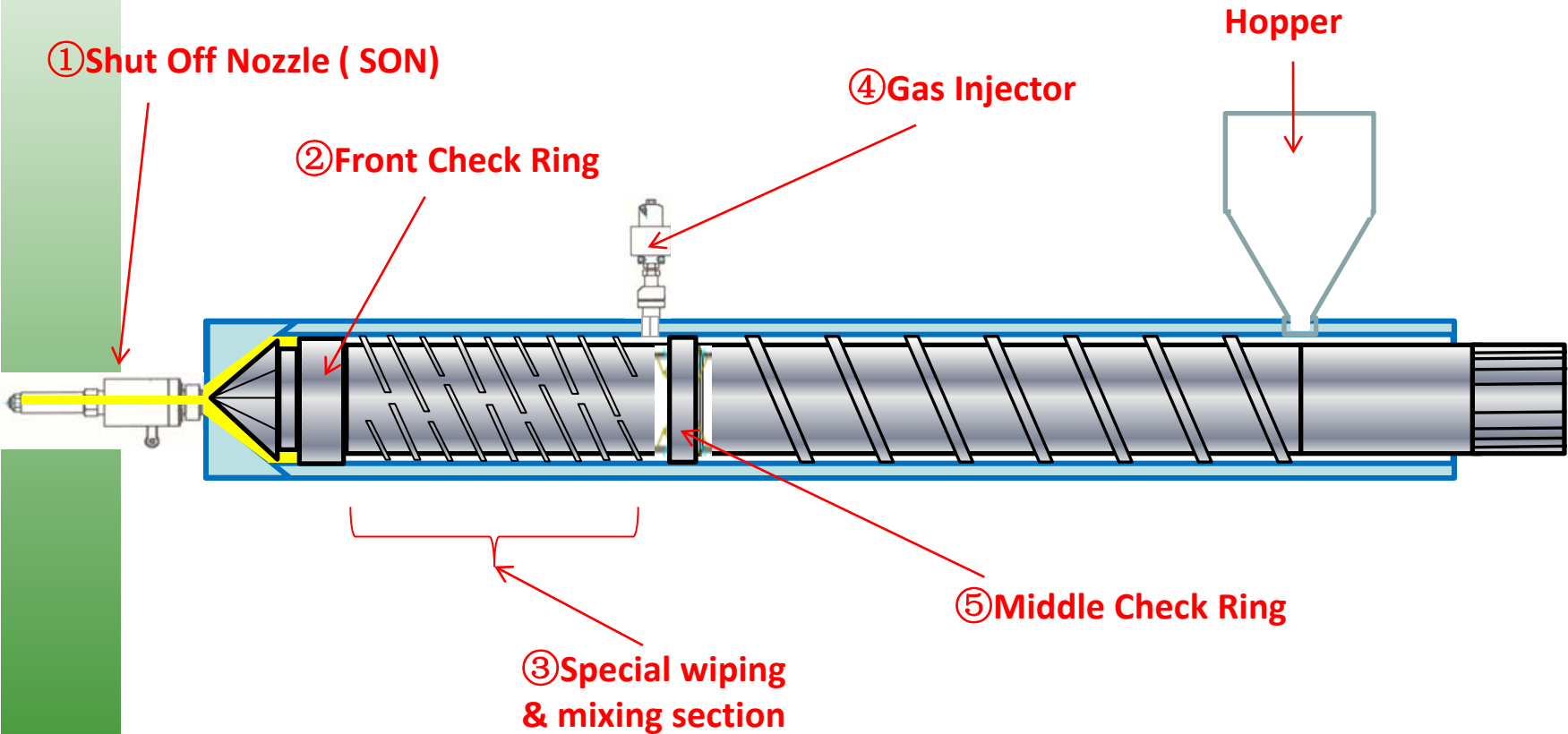
MuCell Principle MuCell原理



- Based entirely on atmospheric gases with no chemical additives 使用大气里的气体、不加任何化学添加剂

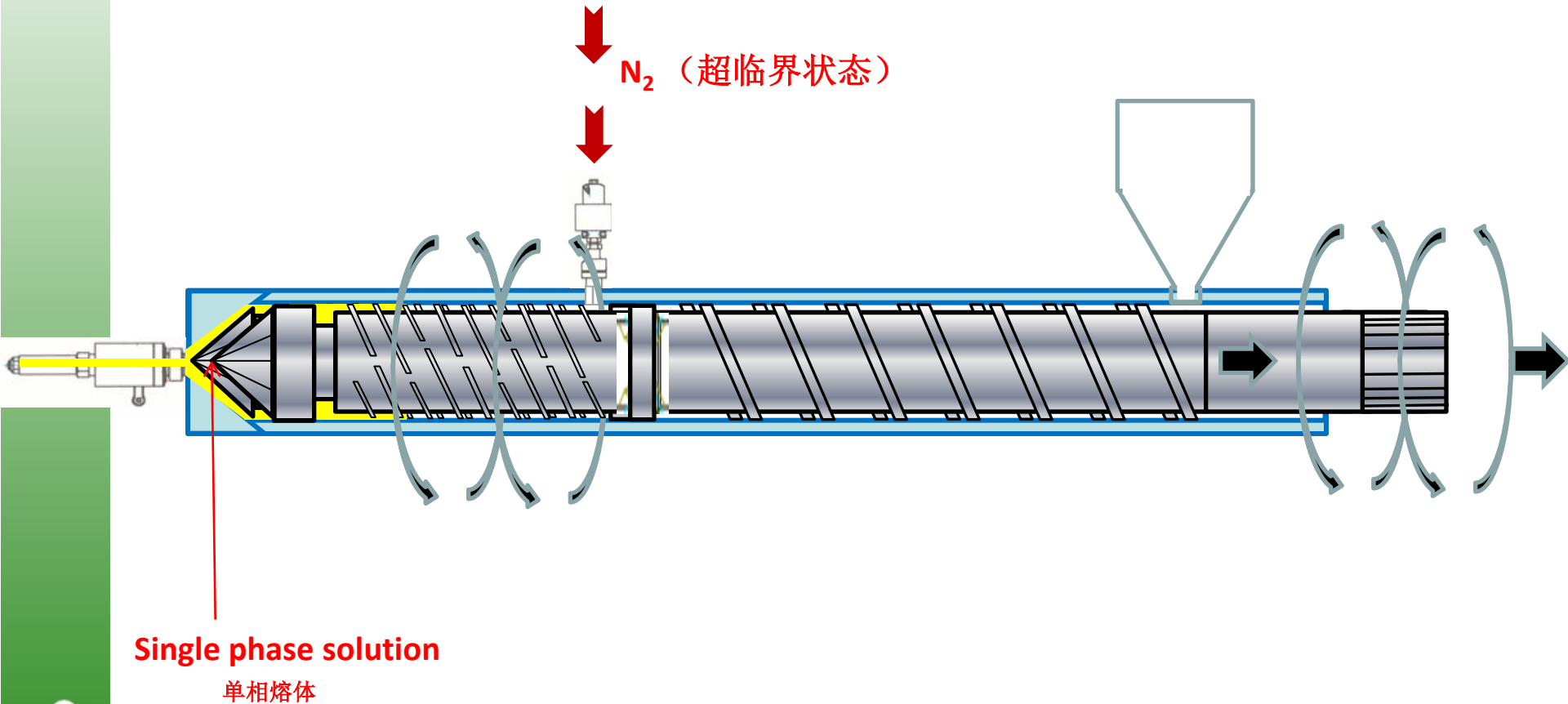
MuCell Operation MuCell 运作

MuCell Injection Unit 特制螺杆和料筒设计



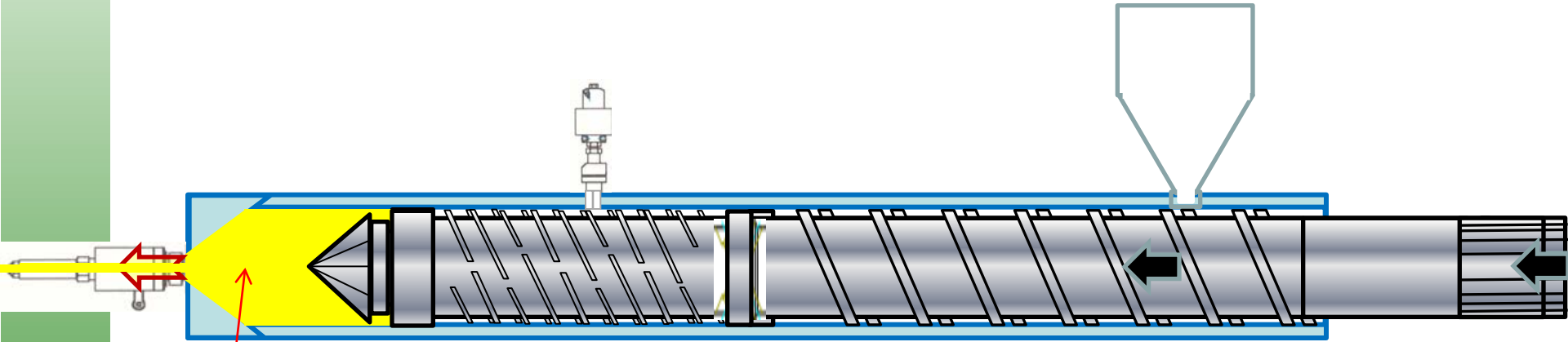
MuCell[®] Operation MuCell[®] 运作

Gas injection + wiping & mixing 气体注射、切割和搅拌



MuCell[®] Operation MuCell[®] 运作

Inject single phase solution into mold 注射单相熔体至模具

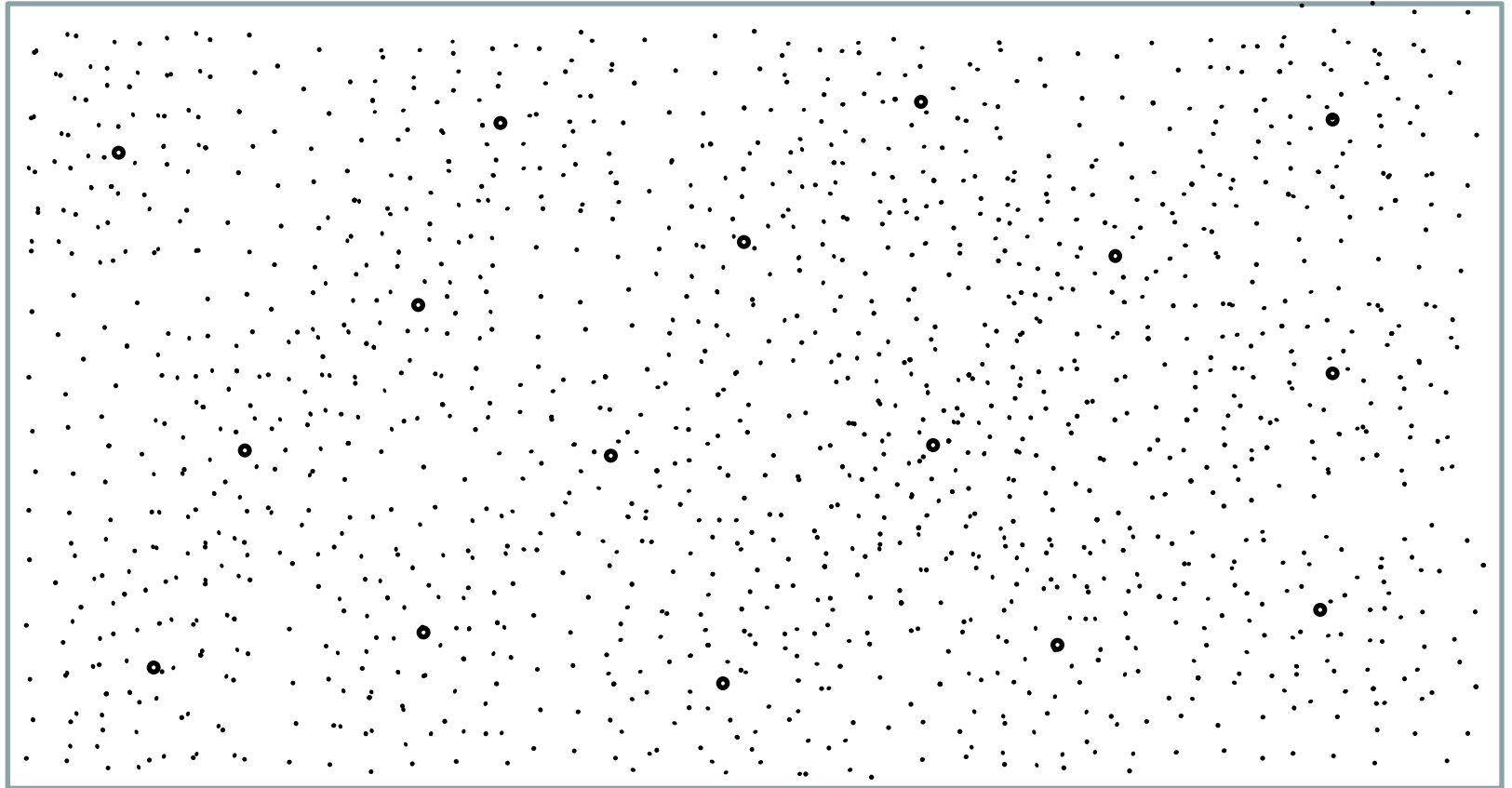


Single phase solution

单相熔体

Good Microcellular Foaming Process

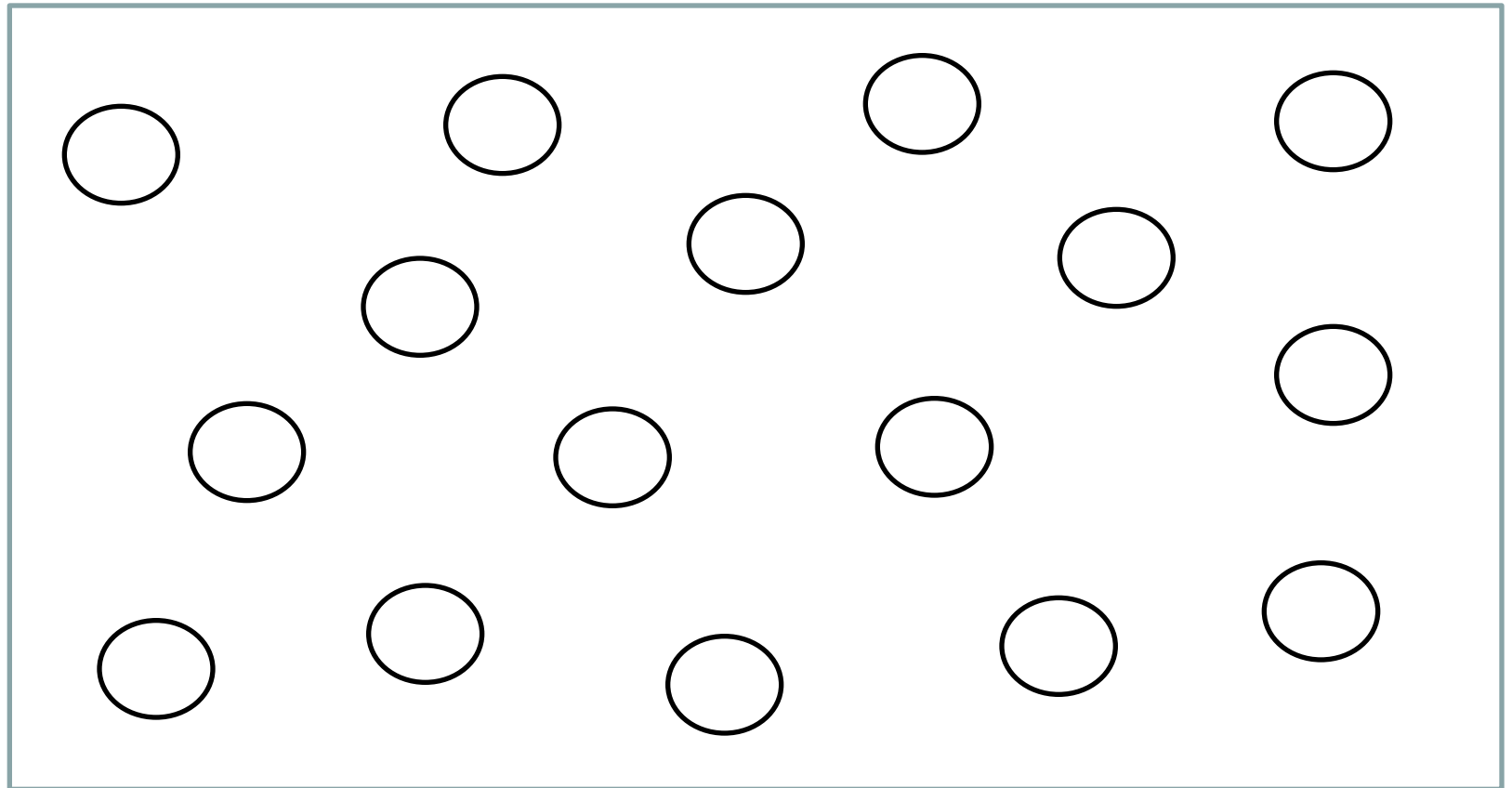
优良的微发泡工艺



1. Create a Single Phase Solution 产生单相熔体
2. Homogeneous Cell Nucleation 均匀的微细胞成核

Good Microcellular Foaming Process

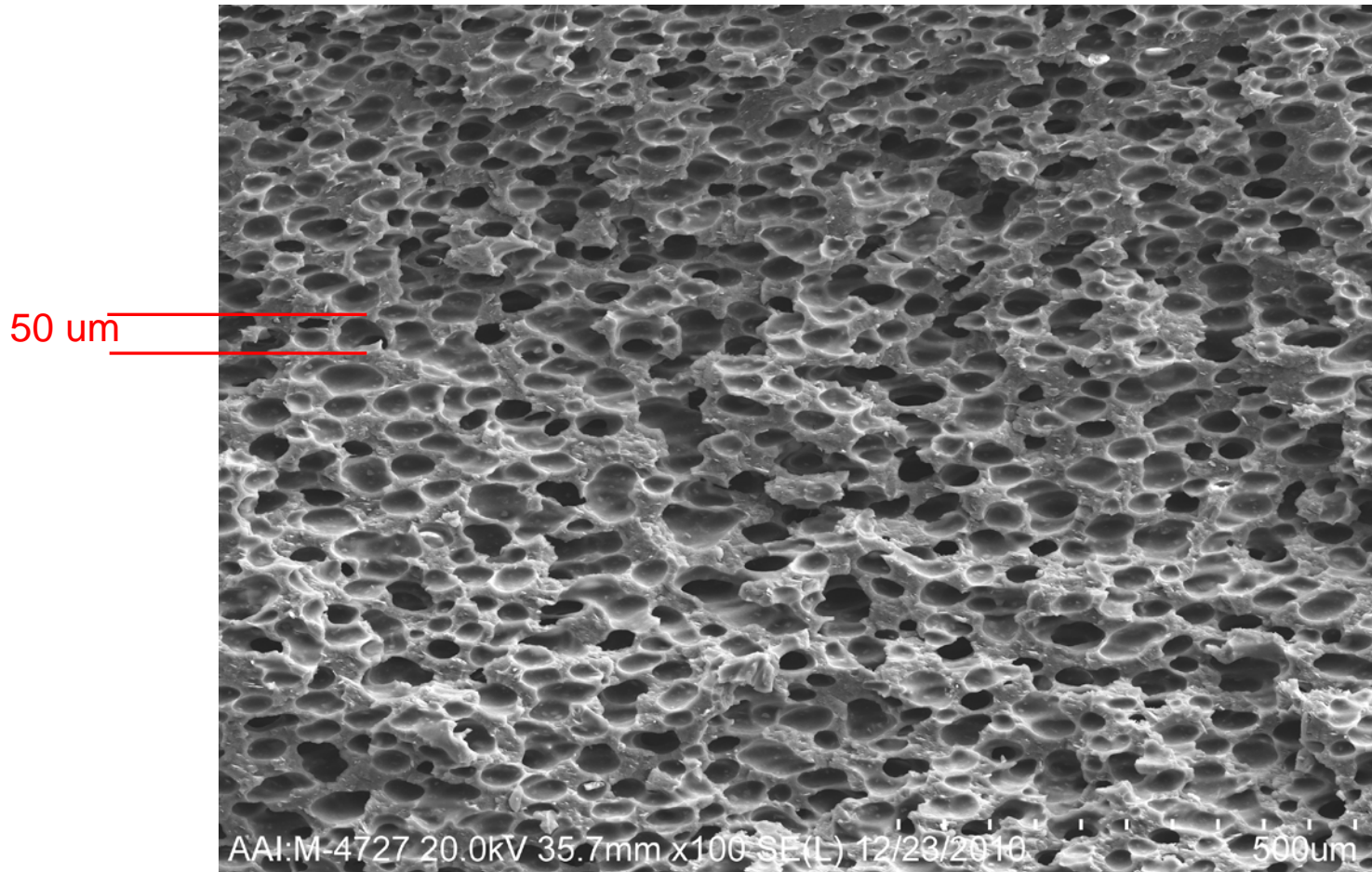
优良的微发泡工艺



1. Create a Single Phase Solution 产生单相熔体
2. Homogeneous Cell Nucleation 均匀的微细胞成核
3. Cell Growth 细胞的成长

Good Microcellular Foaming Process

优良的微发泡工艺



Homogeneous Closed Cell Structure
均匀封闭的泡孔结构

2、Cost Saving 节省成本



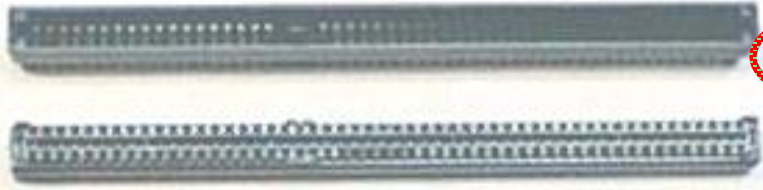
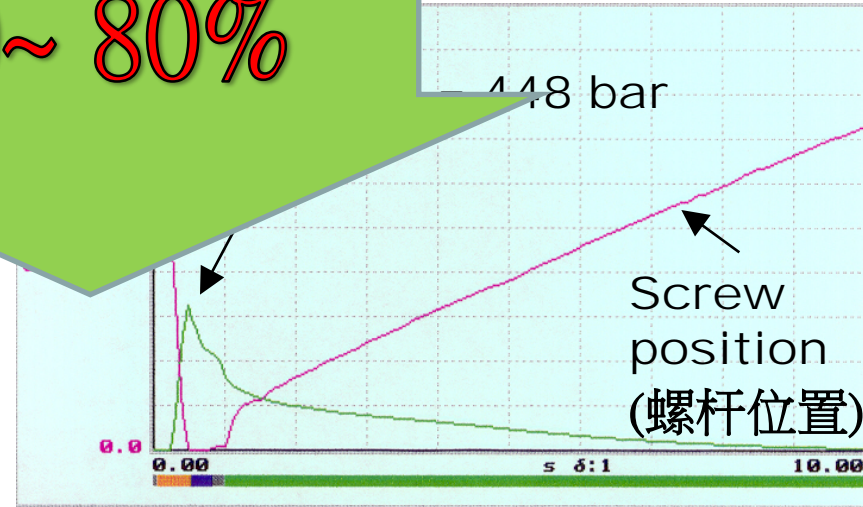
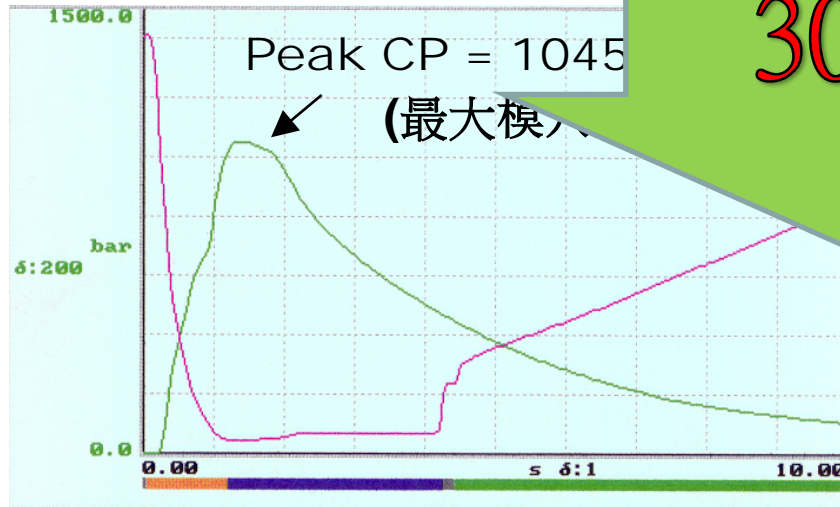
Energy consumption Saving(能耗减少)

- Lower Cavity Pressure (降低模穴压力)

Solid (传统的)

微细发泡)

30~80%



Data Com Connector 30% Glass filled PBT
数据通信连接器30%玻璃纤维添加PBT

- Cavity pressure reduced 57% (模穴压力减少57%)
- 4% weight reduction (重量减少4%)

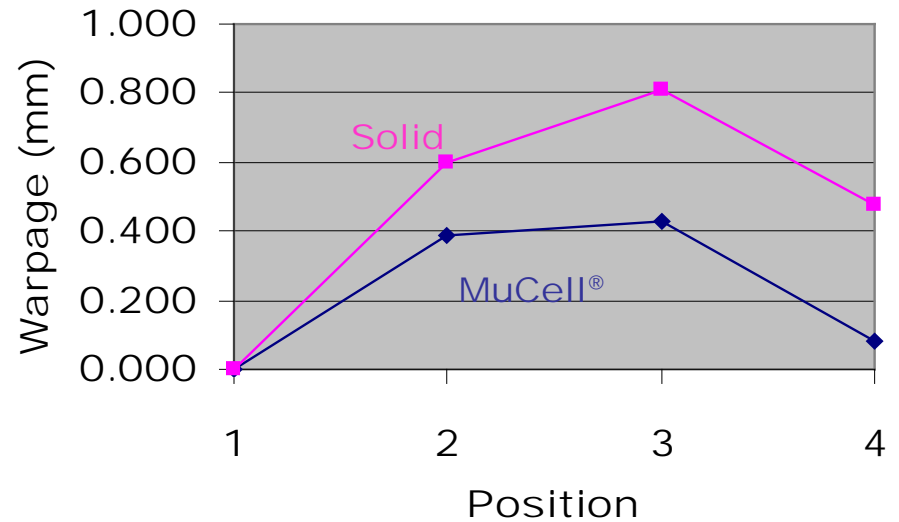
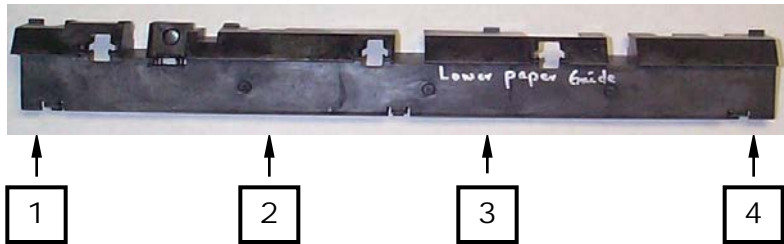


Reduced Flash, Reduced Part Stress, Reduced Clamp Tonnage Machines
(减少毛边,减少内应力,降低锁模力)

Improved Warpage (减少弯曲)

Dimension Stability (尺寸稳定)

Paper Guide 导纸板



Solid warpage 传统翘曲:

0.807 mm

MuCell warpage MuCell翘曲:

0.429 mm

Improvement 改善:

47 %

Increased Yields(提高产量)

①Easier Cavity Filling (更容易填充)

-Reduced viscosity 熔料黏度降低

High Flow PBT

MuCell Strategic Benefit : Currently gating from both ends to fill this part; want to go to a single gate
(改用MuCell后, 浇口數量从2个減为1個)

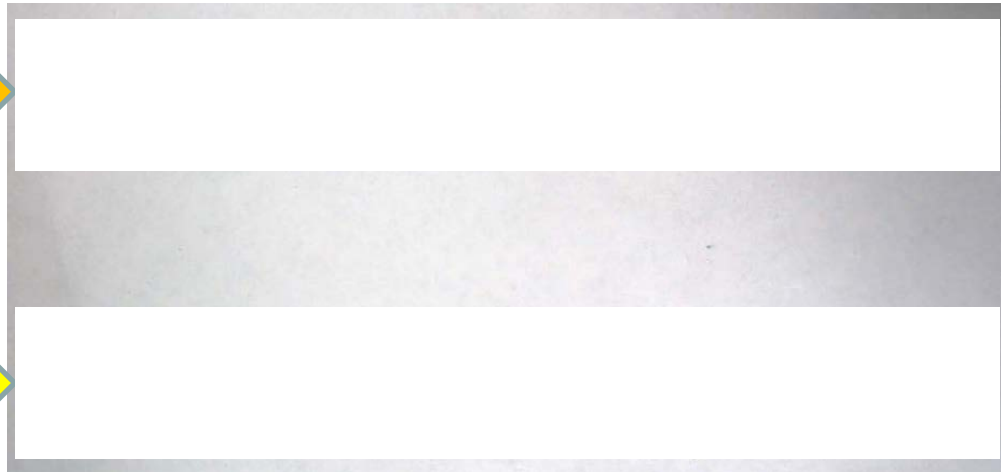


DP Array Body

Solid
single gate fill
(傳統射出, 單浇口填充)



MuCell®
single gate fill
(MuCell®射出, 單浇口填充)

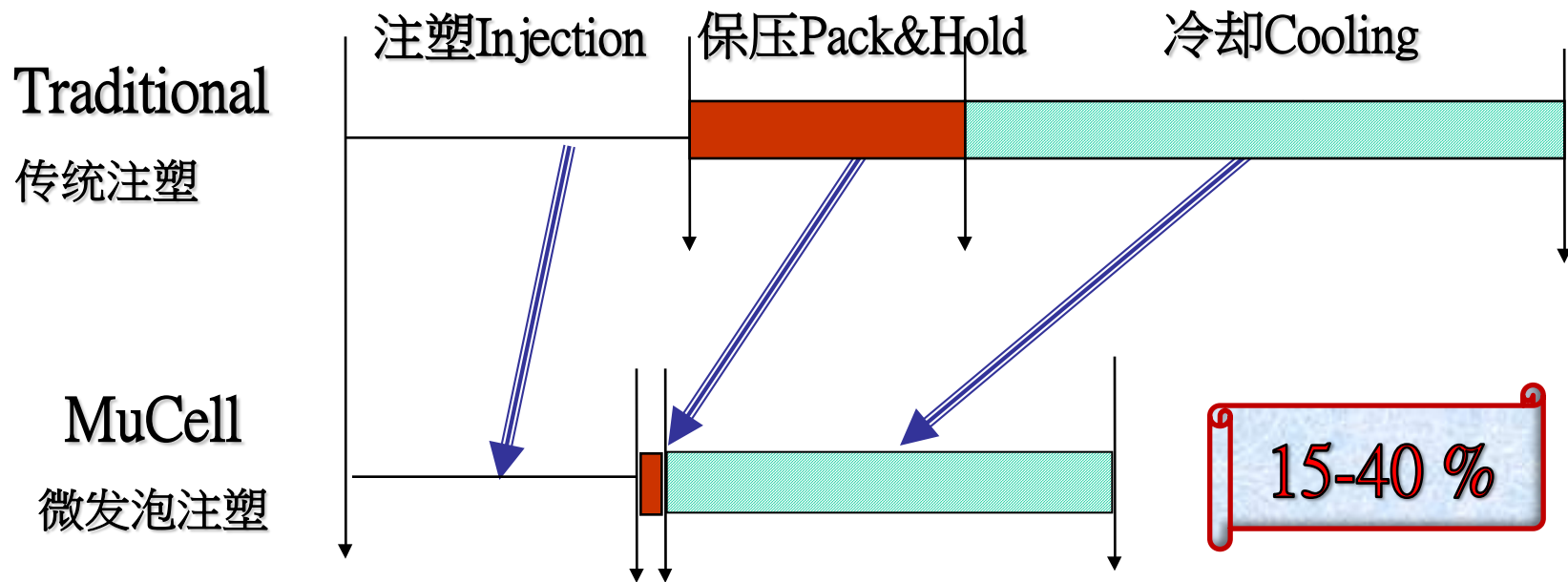


Longer flow length 流动长度变长

Increased Yields(提高产量)

②Reduce cycle time-No Pack & Hold

缩短注塑周期 - 没有保压



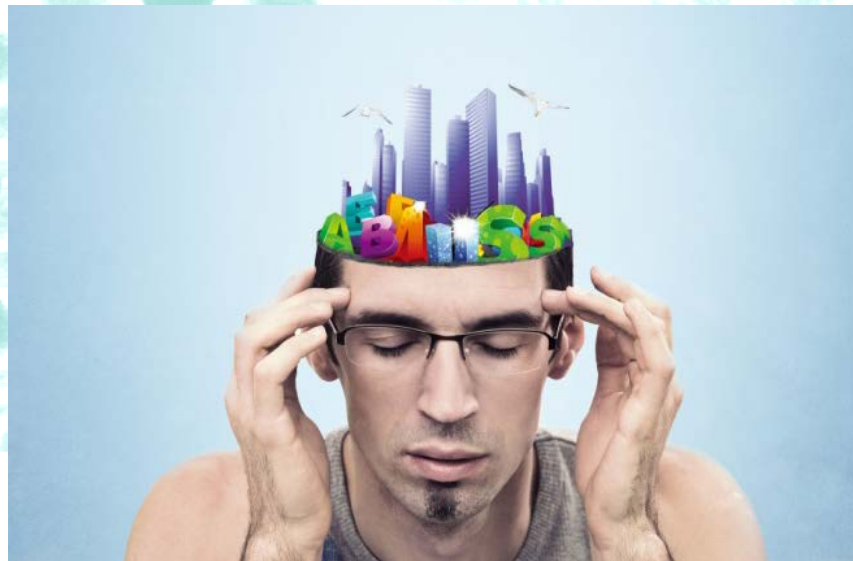
Reduced Resin Consumption(节省材料)

- Product 产品: Water End Tank 水端水箱
- Material 材料: PA66/30GF
- Economic Benefits 经济价值:
 - Cycle Reduction 周期减少: 20%
 - Weight Reduction 重量减少: 20%
 - Tonnage Reduction 吨位减少: 50%
- Quality Benefits 质量提升:
 - Improve warpage (60%) 减少变形(60%)



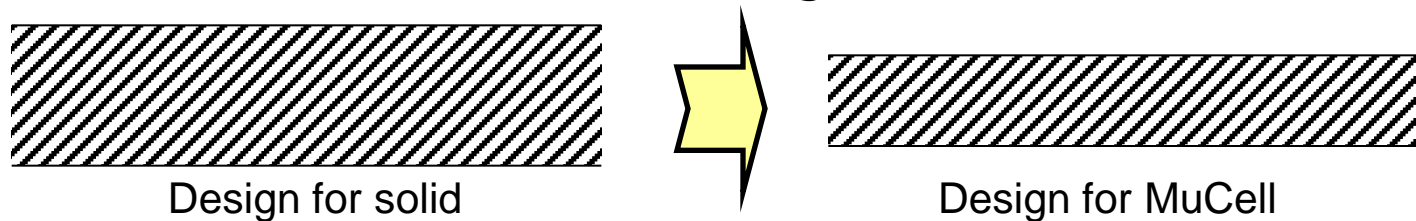
3、Design Freedom

设计更自由

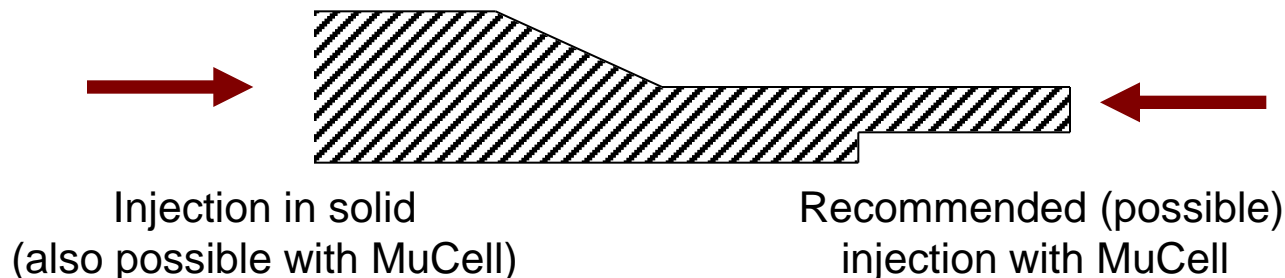


MuCell Design Rules 产品设计新准则

- Cell growth by gas expansion replaces traditional pack phase 气体膨胀细胞变大取代传统保压
- Design for function not for process 是为功能而设计，不是为工艺而设计
 - Reduced viscosity (10% to 15% for a 30% glass fiber) 降低黏度 (30%玻纤 :10%~15%)
 - Thinner nominal wall and higher L/T ratios 更薄壁、更大流长比

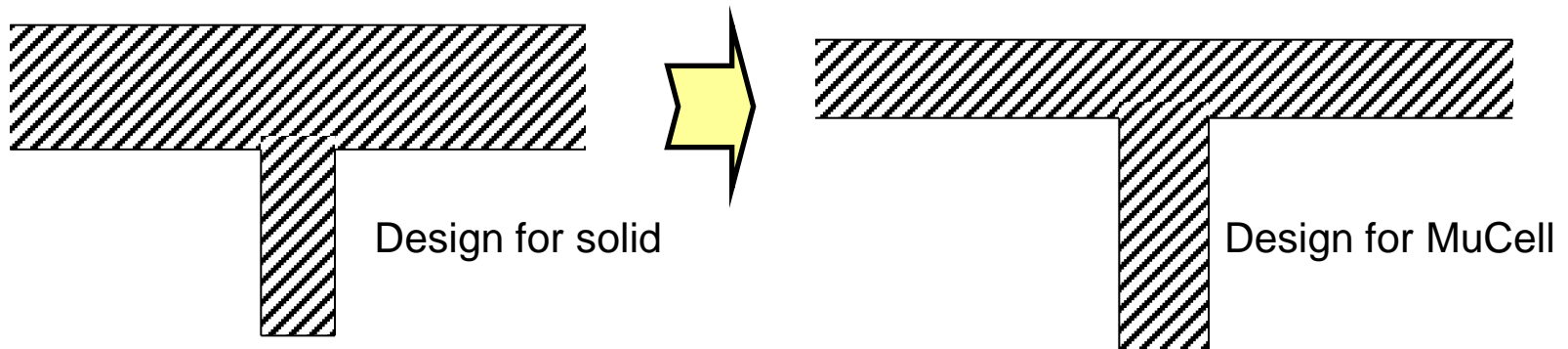


- Greater variations in wall thickness across a part 塑件截面可有较大的壁厚不均



MuCell Design Rules 产品设计新准则

- Rib to wall thicknesses ratios optimized for performance not sink mark elimination. Wall /Rib - thickness ratio 1:1 possible without sink mark. 筋壁厚比为产品性能优化而非缩水。加强筋厚度与塑件厚度之比可达1:1而无缩水痕



- Realistic goal >25% part weight reduction
比较现实的目标25%减重

Interior Door Trim 汽车门内饰件



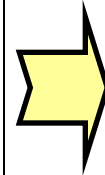
In-Mold Decorated Interior Door Trim :
Volkswagen - 2003 AMPV Platform

Design Drivers 设计重点:

- Energy absorption on impact 冲击下能量吸收
- No visible sink marks through TPV cover 在TPV面版上无缩水痕

Design Without MuCell 传统设计

- Nominal Wall 壁厚: 2.4 mm
- Structural Ribs : 0.8 mm
加强筋厚度



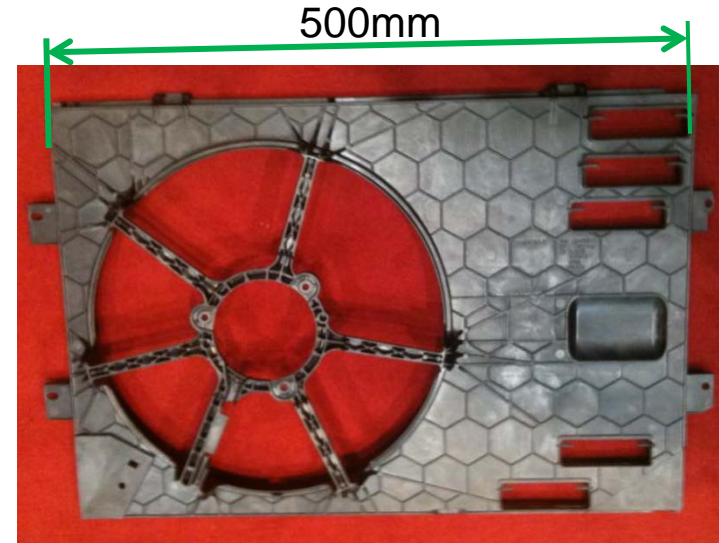
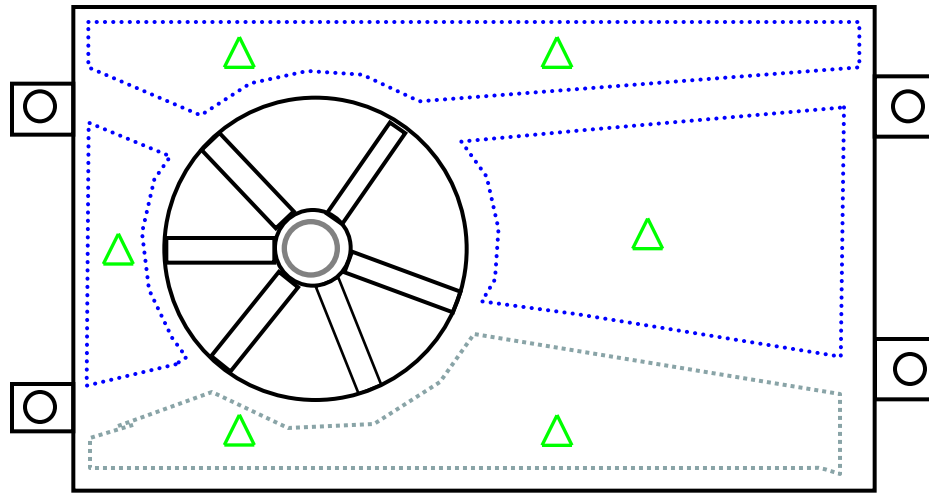
Design With MuCell MuCell设计

- Nominal Wall 壁厚 : 1.8 mm
- Structural Ribs: 1.2 mm
加强筋厚度

Comparison of solid design vs MuCell design 传统和MuCell设计的比较:

- Equivalent energy absorption 相同的能量吸收
- 30% reduction in part weight 减小30%重量 (①+②)
 - ① 20% through wall thickness reduction 20%从减小壁厚
 - ② 10% through density reduction 10%从减小密度

Fan Shrouds 风扇罩



Overall wall thickness 2 mm
全体壁厚为 2mm

It is possible \triangle Scope wall reduced to 1 mm with MuCell
采用MuCell后 \triangle 区域可以减少壁厚至1mm

MuCell Cost Savings 采用MuCell后材料减低:

0.4 kg / part x 300,000 parts / year

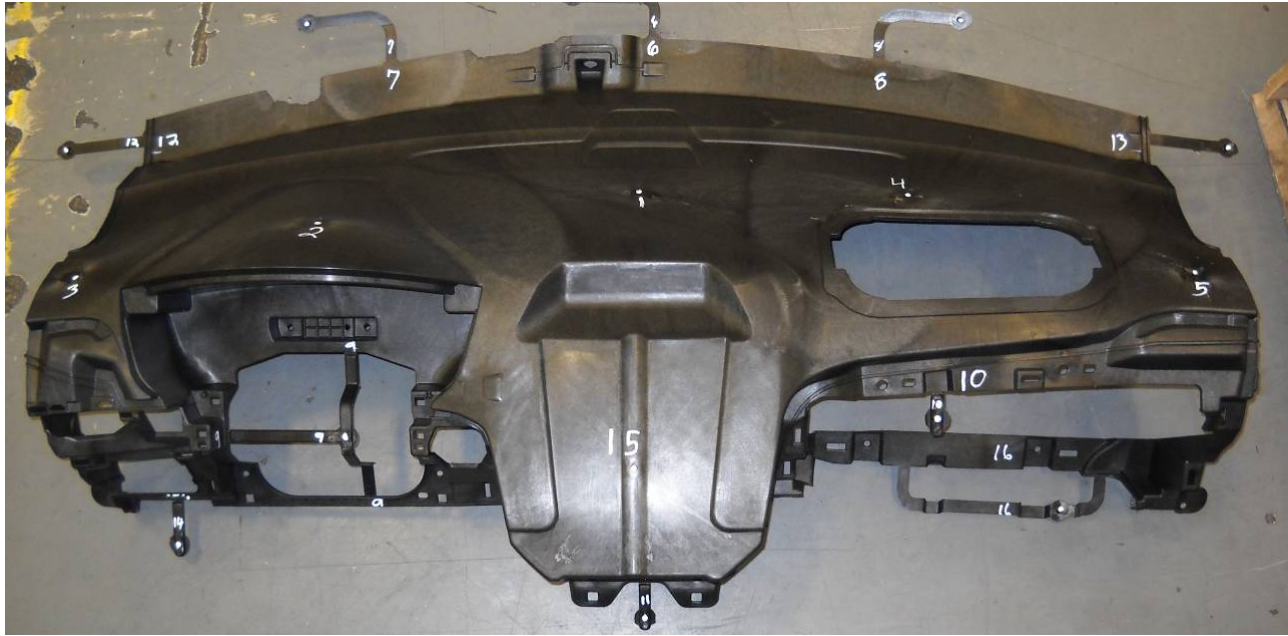
\rightarrow 120 ton / year (PA GF30)



Case Studies

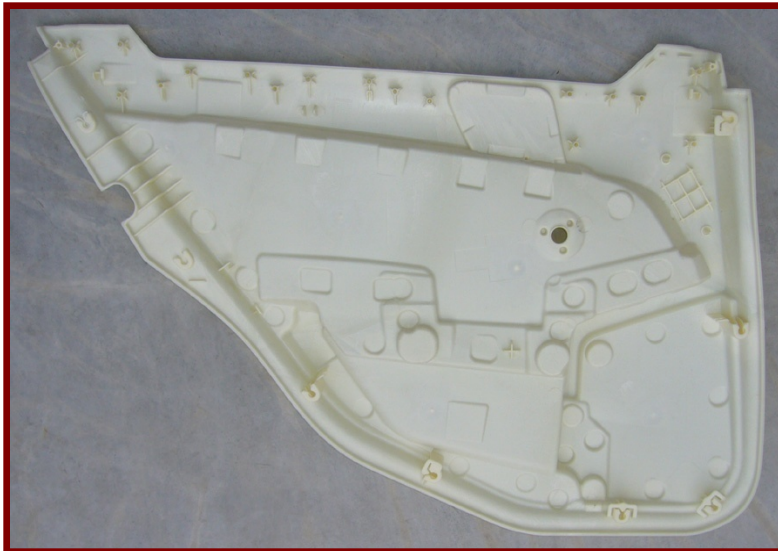
案例分析

Instrument Panel 仪表盘支架



- **Cycle Reduction 成型周期减15%**
- **Weight Reduction 重量减10%**
- **Clamping force reduced from 2500ton to 1200ton 锁模力从2500吨减到1200吨**

MuCell Carrier Rear (RH)



- ⇒ **Thinner general wall (1.8 mm to 2.0 mm)**
平均厚度可以做到1.8mm之2.0mm
- ⇒ **1:1 wall to rib ratio**
1:1肉厚与加强筋比没有缩水
- ⇒ **10 % cycle time reduction**
减少10%的生产周期
- ⇒ **Dimensional stability**
尺寸稳定

Cam Cover



elringklinger

- ⇒ 30 % reduced machine size (350 instead of 500 t for conventional molding) 机器锁模力减少30%
- ⇒ Improved cycle times, which allow for simultaneous production and assembly process 减少成型周期
- ⇒ Lighter part 减轻重量
- ⇒ Improved flatness 减少翘曲

Integrated Sunroof Module 天窗框架一体化



Cadillac

Cadillac CTS
integrated
sunroof
module

Designed by
[Inalfa Roof
Systems
Group](#) (Aubur
n Hills, MI),.

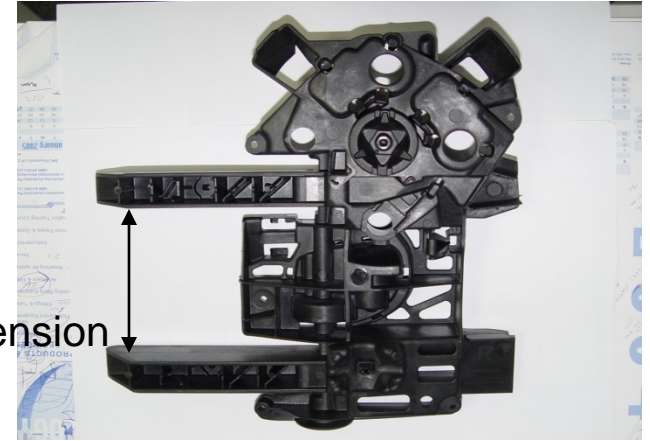
Mirror Assembly Case Frame

后视镜框架

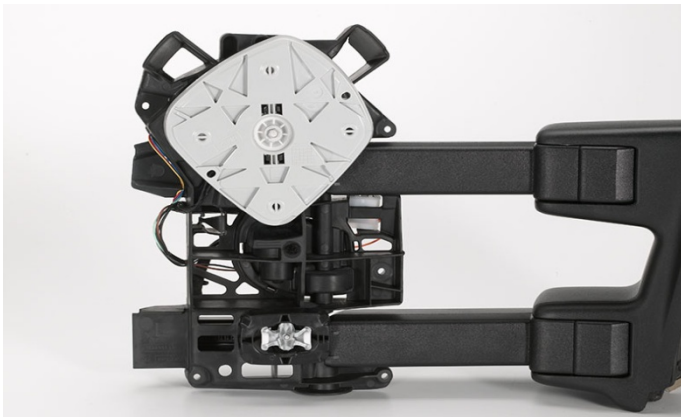
- Reduction of Warpage
减少翘曲
- 10% Cycle Time Reduction
(5 seconds) 减周期10%
- 10% weight reduction
减重10%
- Machine Size 420 VS. 650 Ton
注塑机锁模力从650T减到420T

Schefenacker Vision Systems

Key
Dimension



Ford Case Frame
50% GF PBT



MuCell[®] 2 Component Molding HVAC components

MuCell 二次共塑



Quality improvement



品质提升

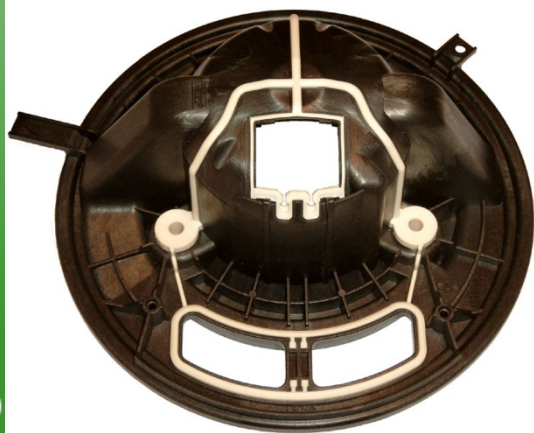


- Improved geometrical stability提高外形几何稳定性

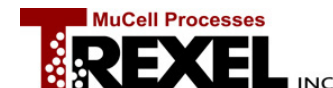


- Elimination of internal stress , warp over hot/cold air region.消除内应力而导致的冷热变形

- No waviness on contour没有渗边



DAIMLERCHRYSLER



MuCell[®] Benefits and Tradeoffs

MuCell[®] 的贡献和局限

Benefits 贡献

- Great improvements in dimensional stability
尺寸的稳定性大大改善
- Faster cycles 周期更快
- Lower weight 更轻
- Lower cavity pressure
填充压力更小
- Smaller machines
可选用较小机台

Tradeoffs 局限

- No transparency
不适用于透明部件
- Avoiding hot runner without valve gate
避免使用没有针阀的热流道
- Surface appearance limits use to non visual parts
因为外观的局限,常常用于非外观件上
 - + **Painting** 喷涂
 - + **IMD/IML** 模内装饰技术
 - + **RHCM** 快速模温转换技术
 - + **Mucell[®] Grade Nylon**
MuCell[®]级尼龙材料

Thank You 谢谢!!

**Herry Liang/梁兆云
Trexel, Inc.**

86-13824407276

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