KOLBENSCHMIDT

Correlação de defeitos e redução de refugo de porosidades com suporte Magmasoft

Rogerio Ferreira

Marcio Rogerio Rocha

Junho 2019

RHEINMETALL AUTOMOTIVE

KOLBENSCHMIDT
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Agenda

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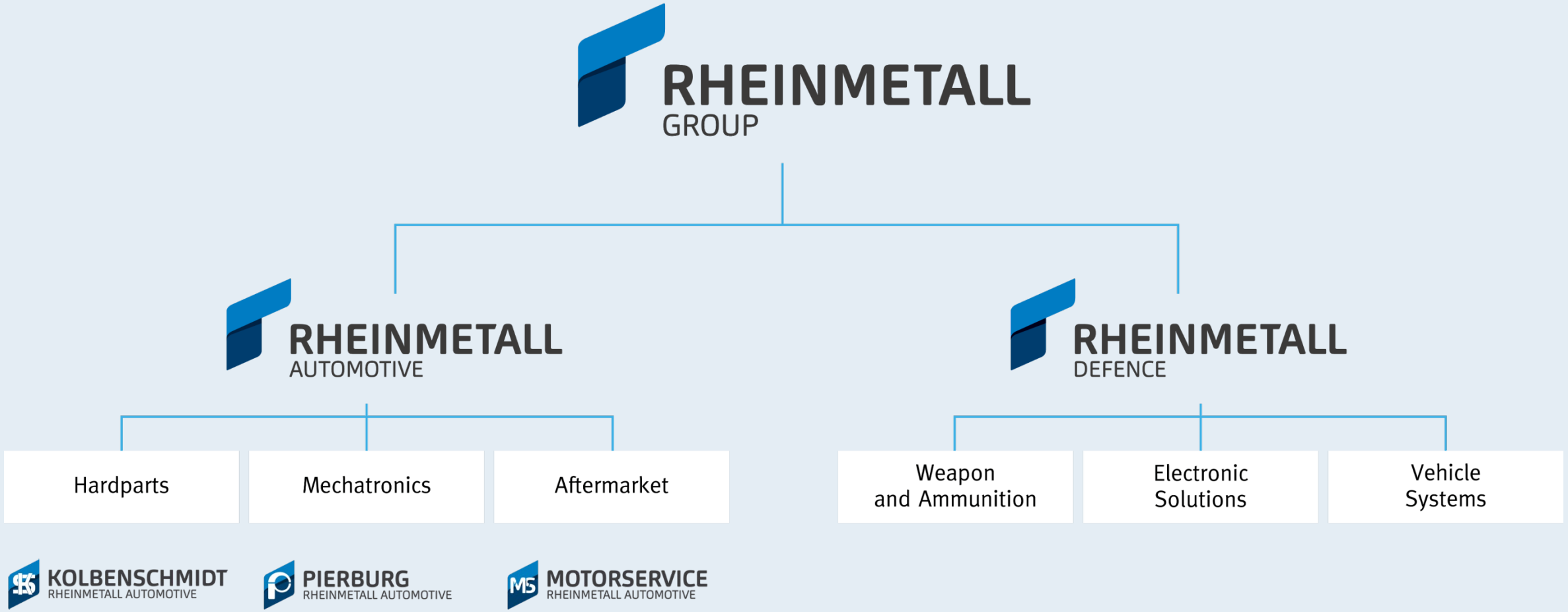
The Group's brand architecture



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Rheinmetall Automotive – Three strong brands under one umbrella

RHEINMETALL AUTOMOTIVE

	KOLBENSCHMIDT	PIERBURG	MOTORSERVICE
Brands			
Business Units	■ Bearings ■ Castings ■ Large Bore Pistons ■ Small Bore Pistons	■ Actuators ■ Automotive Emission Systems ■ Commercial Diesel Systems ■ Pump Technology ■ Solenoid Valves	■ Motorservice is responsible for the global spare parts industry within Rheinmetall Automotive. Engine component sales in more than 130 countries is our core competence.

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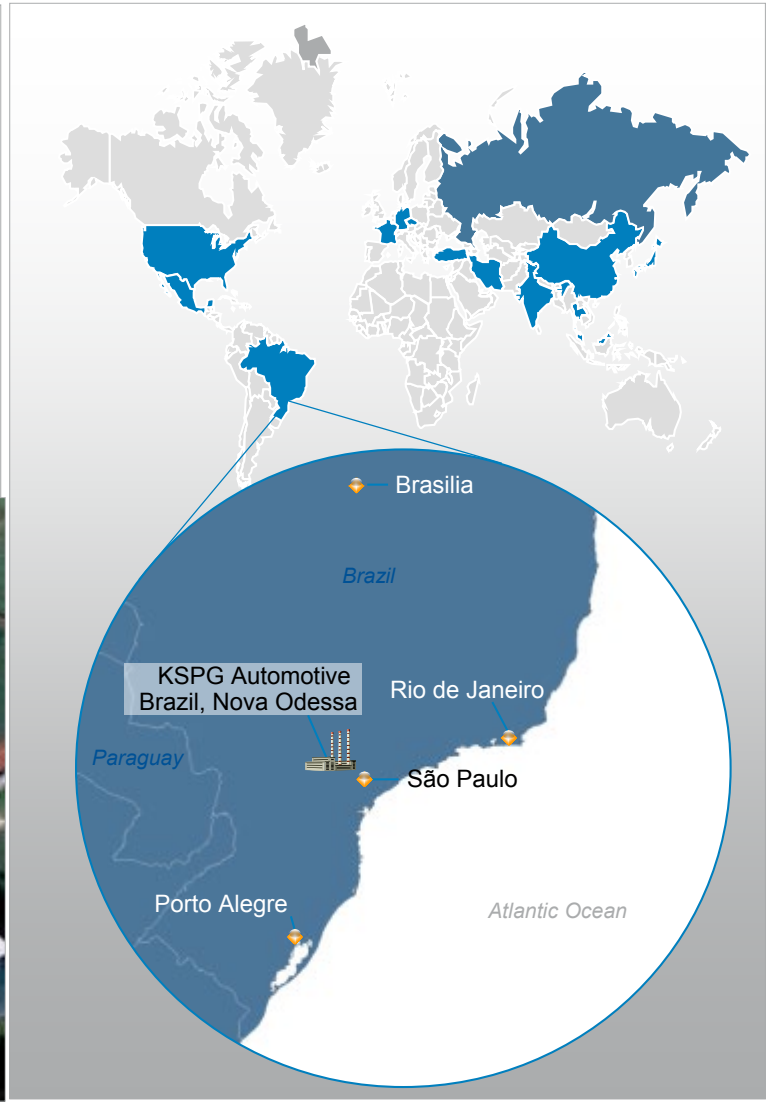
KSPG Automotive Brazil Ltda.

Address	Rod. Arnaldo Júlio Mauerberg 4000 Distrito Industrial 1 13460-000 Nova Odessa-SP/Brazil
Contact	Phone: +55 19 - 3466 - 9700 Fax: +55 19 - 3466 - 9787
Products	Pistons for Gasoline, Commercial Vehicles, 2Stroke Engines for Motorcycles and Cylinders

Global presence: More than 40 locations worldwide



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KSPG Automotive Brazil Ltda.

Constructed Area: 62.000 m² - Nova Odessa Plant

KSPG Automotive Brazil Ltda. – *Pistons Division*

1967 – Established in Santo André / SP

1993 – Moved to Nova Odessa / SP

Employees: 1.134 in three shifts (*)

Constructed Area: 62.000 m²

Products:

Pistons for gasoline and diesel engines

Aluminum cylinders

(*) Basis = May/17

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KSPG Automotive Brazil Ltda. – *Pistons Division*

Products portfolio

Pistons for gasoline and diesel engines from 35 to 140 mm Ø

Around 14 million units/year

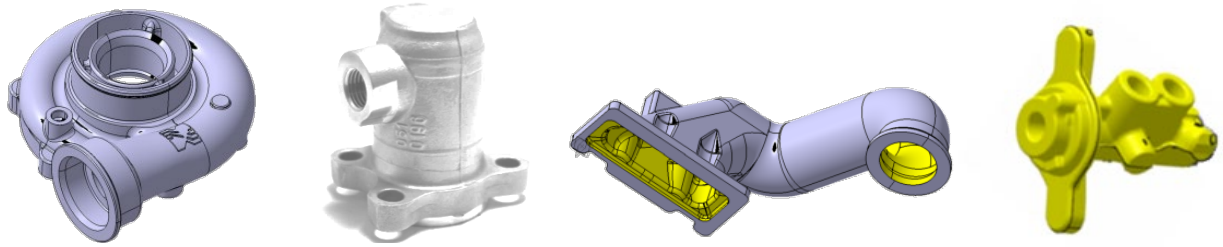
Bare pistons and assembled pistons

Cylinders for chain saws

Around 0.55 million units/year

Cylinders assembly

Casting Parts



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KSP Customers Panel

Domestic Customers

AGCO SISU POWER
VALTRA
BorgWarner
Cummins
CNH INDUSTRIAL
Ford
GM
HONDA Automobiles
HONDA
Husqvarna
MAN
Mercedes-Benz
MWM INTERNATIONAL
Perkins
CATERPILLAR
PSA PEUGEOT CITROËN
RENAULT NISSAN
SCANIA
STIHL
WABCO
VOLVO
YAMAHA

Export Customers

AGCO SISU POWER
ASTON MARTIN
CNH INDUSTRIAL
Cummins
DAF
DEUTZ
FIAT
Ford
GM
Husqvarna
IVECO
MAN
Mercedes-Benz
Perkins
CATERPILLAR
PSA PEUGEOT CITROËN
RENAULT NISSAN
SCANIA
STIHL
VM MOTORI

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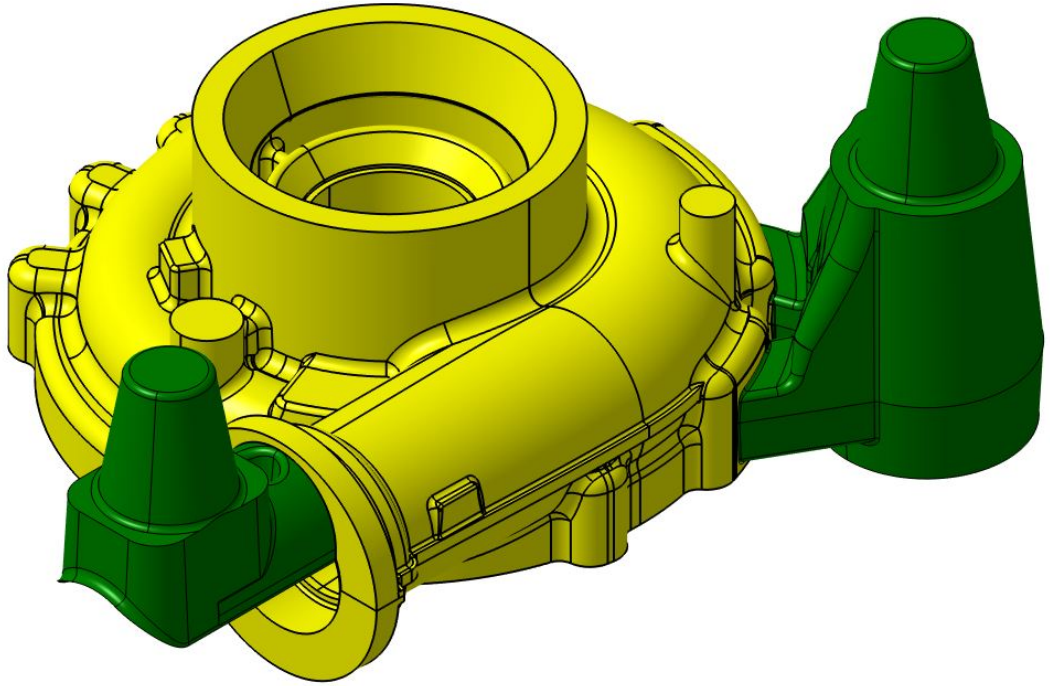
Estudo de correlação para defeito no turbo compressor
Trabalho em parceria com o suporte da MAGMA Engenharia do Brasil



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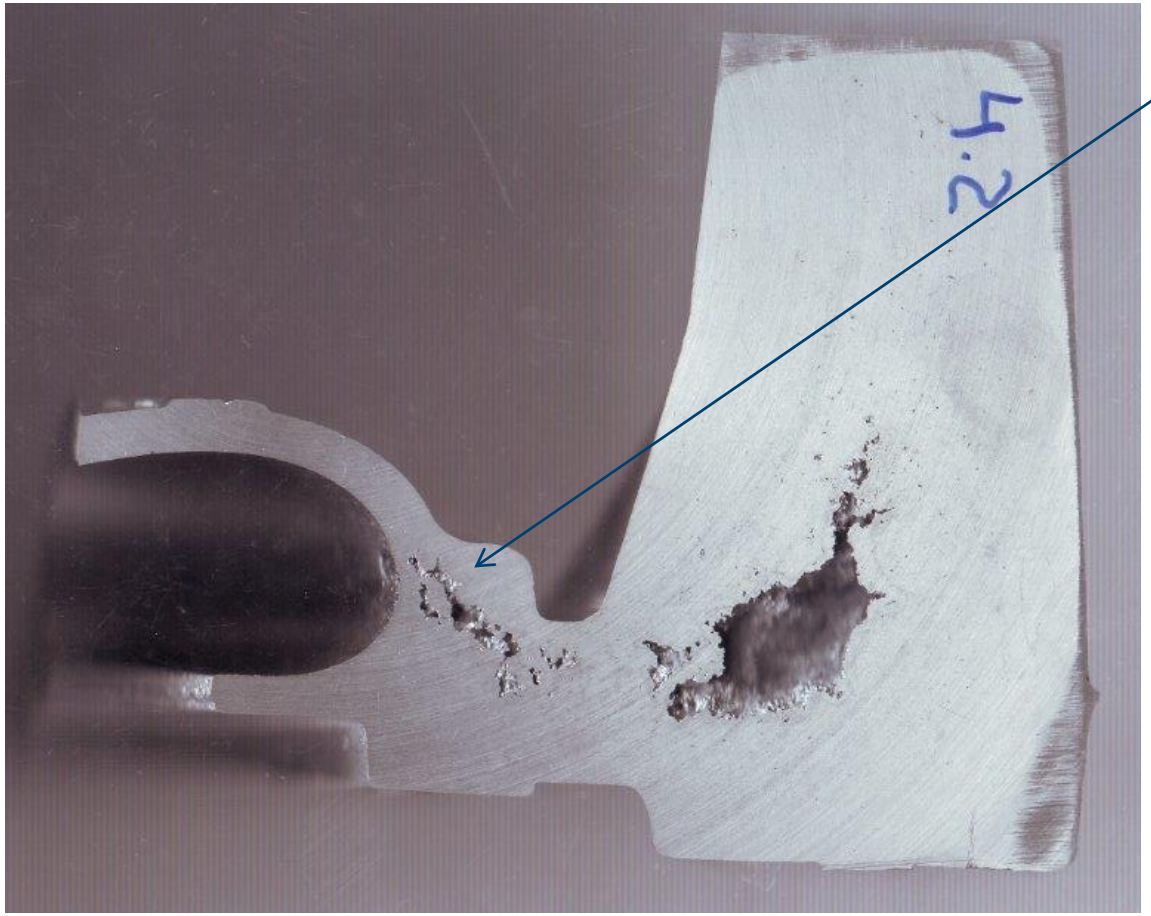
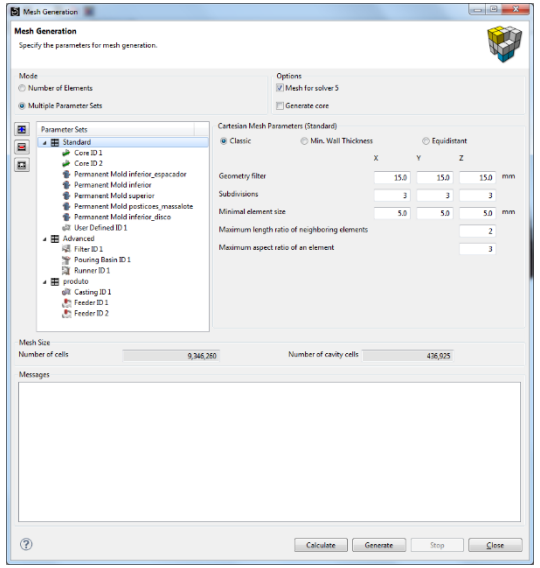
❑ Identificação do defeito

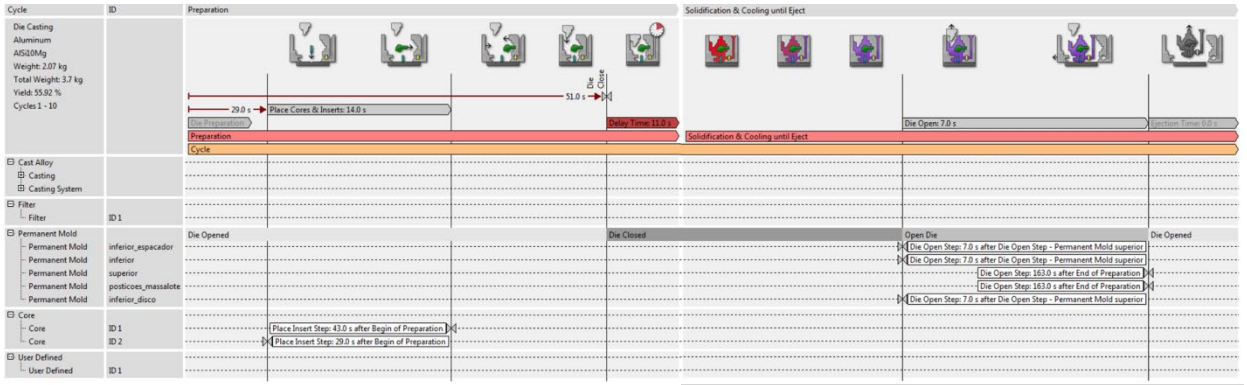


Rechupe na região do massalote lateral

Refugo : 20,59%

- ***Ajustes da simulação com suporte Magma***
- ***Ajustes da malha***
- ***Ajustes de temperatura e tempos de ciclo***
- ***Ajustes de HTC´s***
- ***Ajustes de curva de termopares***





Material 1	Mat ID	Material 2	Mat ID	Database/Filename	Type
Cast Alloy		Permanent Mold			
Casting		Permanent Mold			
Casting	ID 1	Permanent Mold	inferior	Project/AlSi10Mg-2000	Temperature Dependent HTC
Casting	ID 1	Permanent Mold	superior	Project/AlSi10Mg-2000	Temperature Dependent HTC
Casting	ID 1	Permanent Mold	inferior_disco	Project/AlSi10Mg-2000	Temperature Dependent HTC
Casting System		Permanent Mold			
Feeder	ID 1	Permanent Mold	superior	Project/AlSi10Mg-2000	Temperature Dependent HTC
Feeder	ID 1	Permanent Mold	posticoes_massalote	Project/AlSi10Mg-2000	Temperature Dependent HTC
Feeder	ID 2	Permanent Mold	inferior	Project/AlSi10Mg-2000	Temperature Dependent HTC
Feeder	ID 2	Permanent Mold	superior	Project/AlSi10Mg-2000	Temperature Dependent HTC
Feeder	ID 2	Permanent Mold	posticoes_massalote	Project/AlSi10Mg-2000	Temperature Dependent HTC
Runner	ID 1	Permanent Mold	inferior_disco	Project/AlSi10Mg-2000	Temperature Dependent HTC
Cast Alloy		Core			
Casting		Core			
Casting	ID 1	Core	ID 1	MAGMA/AlSi10Mg-core	Temperature Dependent HTC
Casting	ID 1	Core	ID 2	MAGMA/AlSi10Mg-core	Temperature Dependent HTC
Casting System		Core			
Feeder	ID 1	Core	ID 1	MAGMA/AlSi10Mg-core	Temperature Dependent HTC
Runner	ID 1	Core	ID 2	MAGMA/AlSi10Mg-core	Temperature Dependent HTC
Pouring Basin	ID 1	Core	ID 2	MAGMA/AlSi10Mg-core	Temperature Dependent HTC
Filter		Core			
Filter	ID 1	Core	ID 2	MAGMA/AlSi10Mg-core	Temperature Dependent HTC
Permanent Mold		Permanent Mold			
Permanent Mold	inferio	Permanent Mold	inferior	Project/MERGE_C2000	Constant HTC
Permanent Mold	inferi...	Permanent Mold	superior	MAGMA/C2000.0	Constant HTC
Permanent Mold	inferi...	Permanent Mold	inferior_disco	Project/MERGE_C2000	Constant HTC
Permanent Mold	superi	Permanent Mold	posticoes_massalote	Project/MERGE_C2000	Constant HTC
Permanent Mold		Core			
Permanent Mold	inferi...	Core	ID 1	Project/MERGE_C1000	Constant HTC
Permanent Mold	superi	Core	ID 1	Project/MERGE_C1000	Constant HTC
Permanent Mold	superi	Core	ID 2	Project/MERGE_C1000	Constant HTC
Permanent Mold	inferio	Core	ID 1	Project/MERGE_C1000	Constant HTC
Permanent Mold		User Defined			
Permanent Mold	superi	User Defined	ID 1	MAGMA/C100.0	Constant HTC
Core		User Defined			
Core	ID 1	User Defined	ID 1	MAGMA/C100.0	Constant HTC
Core	ID 2	User Defined	ID 1	MAGMA/C100.0	Constant HTC

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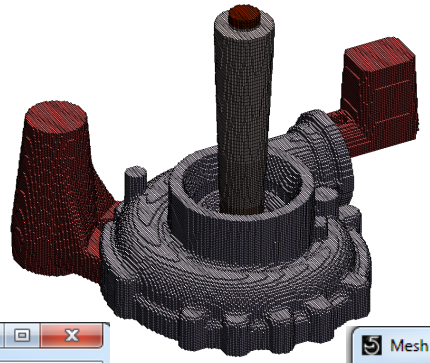
- ***Ajustes da simulação com suporte Magma***
- ***Ajustes da malha***



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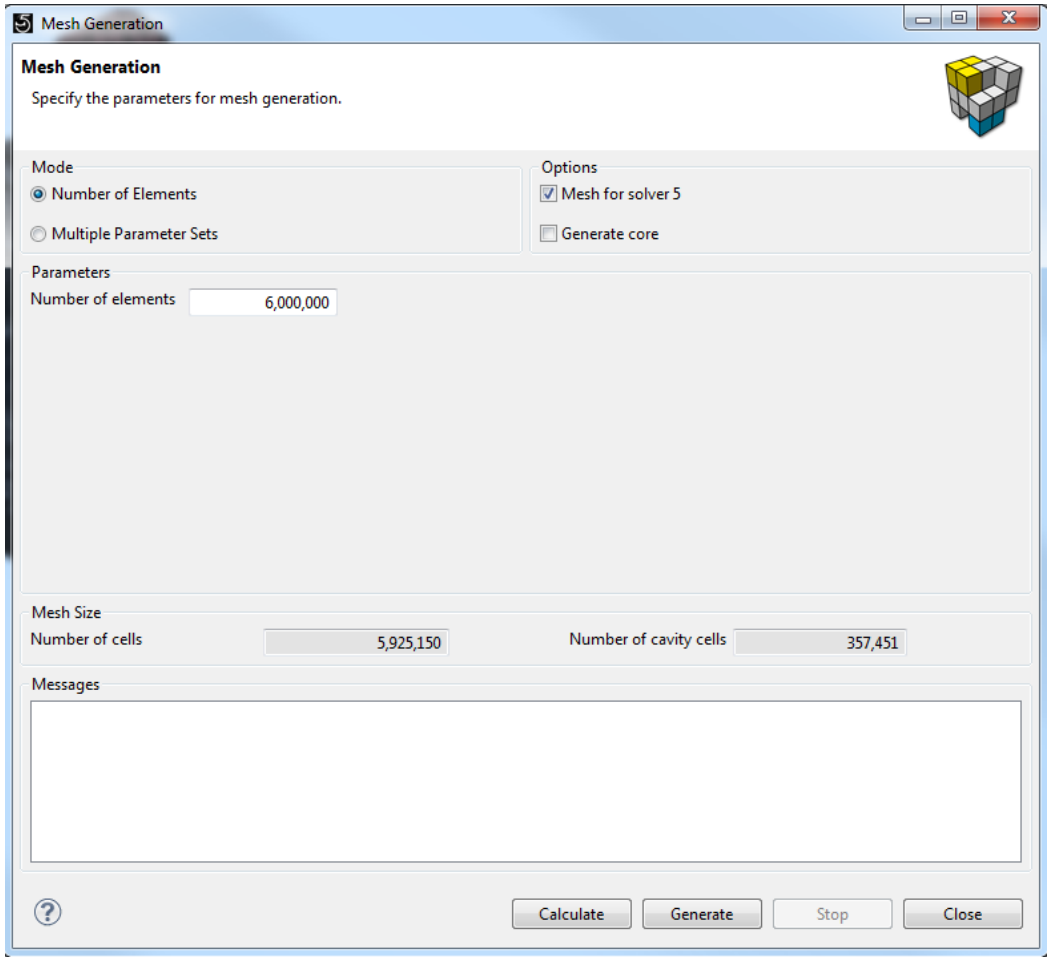
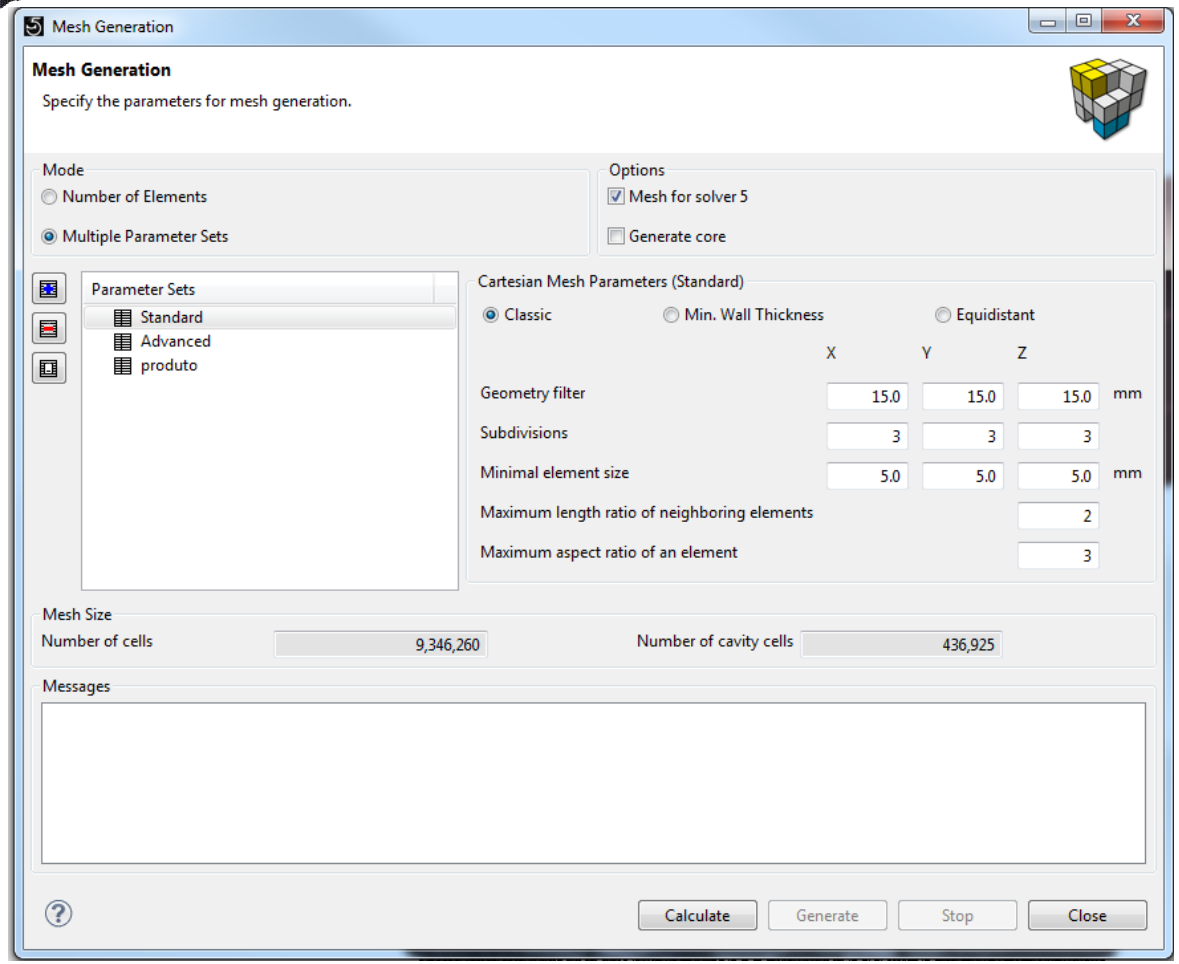


Versão alterada



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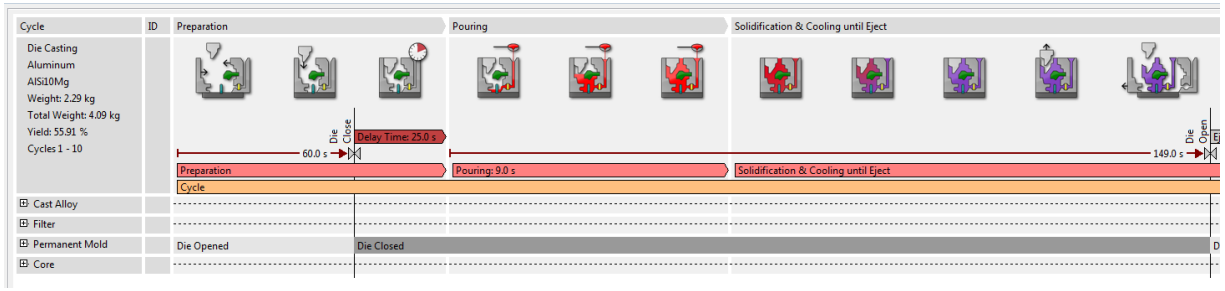
- ***Ajustes da simulação com suporte Magma***
- ***Ajustes de temperatura e tempos de ciclo***

Versão original



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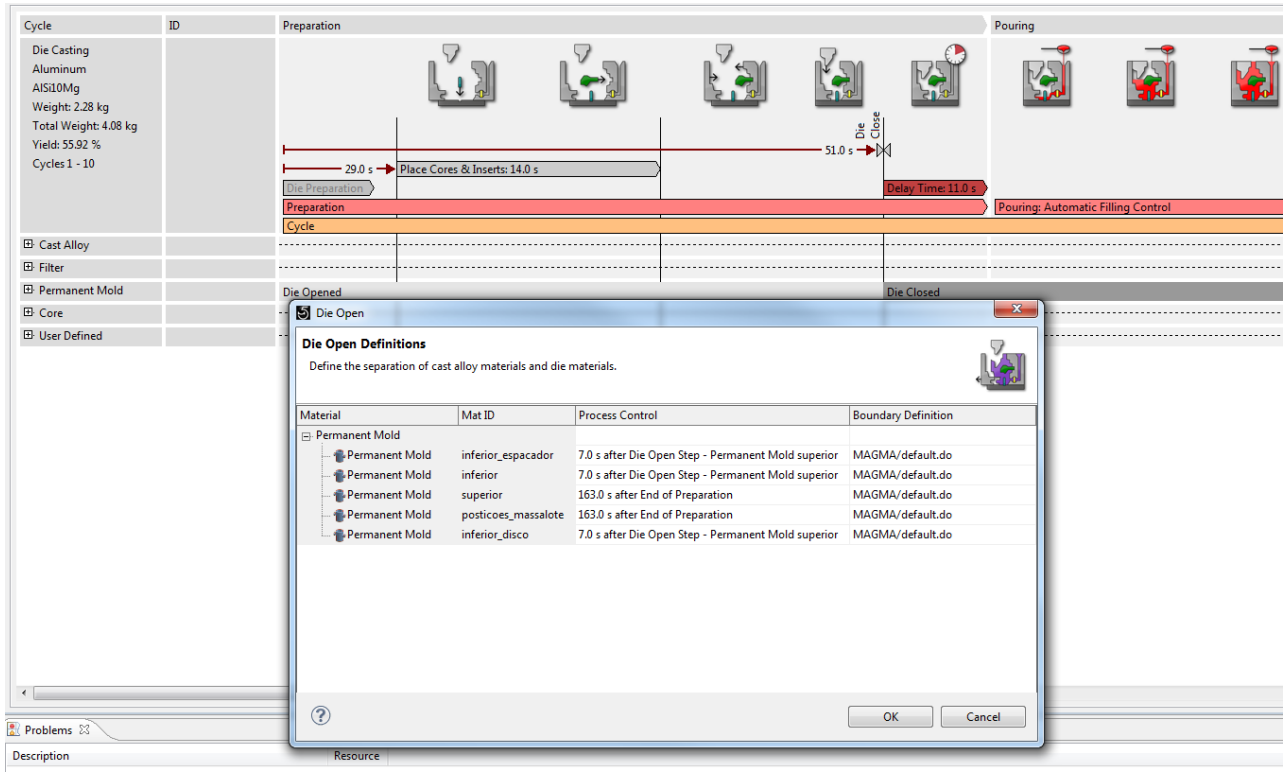

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- ***Ajustes da simulação com suporte Magma***
- ***Ajustes de HTC´s***

Versão original

Material 1	Mat ID	Material 2	Mat ID	Database/Filename	Type
Cast Alloy		Permanent Mold			
Casting		Permanent Mold			
Casting	ID 1	Permanent Mold	ID 2	Project/al-fe-ab	Temperature Dependent HTC
Casting	ID 1	Permanent Mold	ID 3	Project/al-fe-ab	Temperature Dependent HTC
Casting	ID 1	Permanent Mold	ID 5	Project/al-fe-ab	Temperature Dependent HTC
Casting System		Permanent Mold			
Feeder	ID 1	Permanent Mold	ID 3	MAGMA/AlSi10Mg-coat	Temperature Dependent HTC
Feeder	ID 2	Permanent Mold	ID 2	MAGMA/AlSi10Mg-coat	Temperature Dependent HTC
Feeder	ID 2	Permanent Mold	ID 3	MAGMA/AlSi10Mg-coat	Temperature Dependent HTC
Runner	ID 1	Permanent Mold	ID 5	Project/al-fe-ab	Temperature Dependent HTC
Cast Alloy		Core			
Casting		Core			
Casting	ID 1	Core	ID 1	MAGMA/AlSi10Mg-core	Temperature Dependent HTC
Casting	ID 1	Core	ID 2	MAGMA/AlSi10Mg-core	Temperature Dependent HTC
Casting System		Core			
Feeder	ID 1	Core	ID 1	MAGMA/AlSi10Mg-coat	Temperature Dependent HTC
Runner	ID 1	Core	ID 2	MAGMA/AlSi10Mg-coat	Temperature Dependent HTC
Filter		Core			
Filter	ID 1	Core	ID 2	Project/al-fe-ab	Temperature Dependent HTC
Permanent Mold		Permanent Mold		<defined individually>	Constant HTC
Permanent Mold		Core		Project/MERGE_C2000	Constant HTC

Versão alterada

Material 1	Mat ID	Material 2	Mat ID	Database/Filename	Type
Cast Alloy		Permanent Mold			
Casting		Permanent Mold			
Casting	ID 1	Permanent M	inferi...	Project/AlSi10Mg-2000	Temperature Dependent HTC
Casting	ID 1	Permanent M	superi	Project/AlSi10Mg-2000	Temperature Dependent HTC
Casting	ID 1	Permanent M	inferio	Project/AlSi10Mg-2000	Temperature Dependent HTC
Casting System		Permanent Mold			
Feeder	ID 1	Permanent M	superi	Project/AlSi10Mg-2000	Temperature Dependent HTC
Feeder	ID 1	Permanent M	postic	Project/AlSi10Mg-2000	Temperature Dependent HTC
Feeder	ID 2	Permanent M	inferi...	Project/AlSi10Mg-2000	Temperature Dependent HTC
Feeder	ID 2	Permanent M	superi	Project/AlSi10Mg-2000	Temperature Dependent HTC
Feeder	ID 2	Permanent M	postic	Project/AlSi10Mg-2000	Temperature Dependent HTC
Runner	ID 1	Permanent M	inferio	Project/AlSi10Mg-2000	Temperature Dependent HTC
Cast Alloy		Core			
Casting		Core			
Casting	ID 1	Core	ID 1	MAGMA/AlSi10Mg-core	Temperature Dependent HTC
Casting	ID 1	Core	ID 2	MAGMA/AlSi10Mg-core	Temperature Dependent HTC
Casting System		Core			
Feeder	ID 1	Core	ID 1	MAGMA/AlSi10Mg-core	Temperature Dependent HTC
Runner	ID 1	Core	ID 2	MAGMA/AlSi10Mg-core	Temperature Dependent HTC
Pouring Basin	ID 1	Core	ID 2	MAGMA/AlSi10Mg-core	Temperature Dependent HTC
Filter		Core		MAGMA/AlSi10Mg-core	Temperature Dependent HTC
Permanent Mold		Permanent Mold		<defined individually>	Constant HTC
Permanent Mold		Core		Project/MERGE_C1000	Constant HTC
Permanent Mold		User Defined		MAGMA/C100.0	Constant HTC
Core		User Defined		MAGMA/C100.0	Constant HTC

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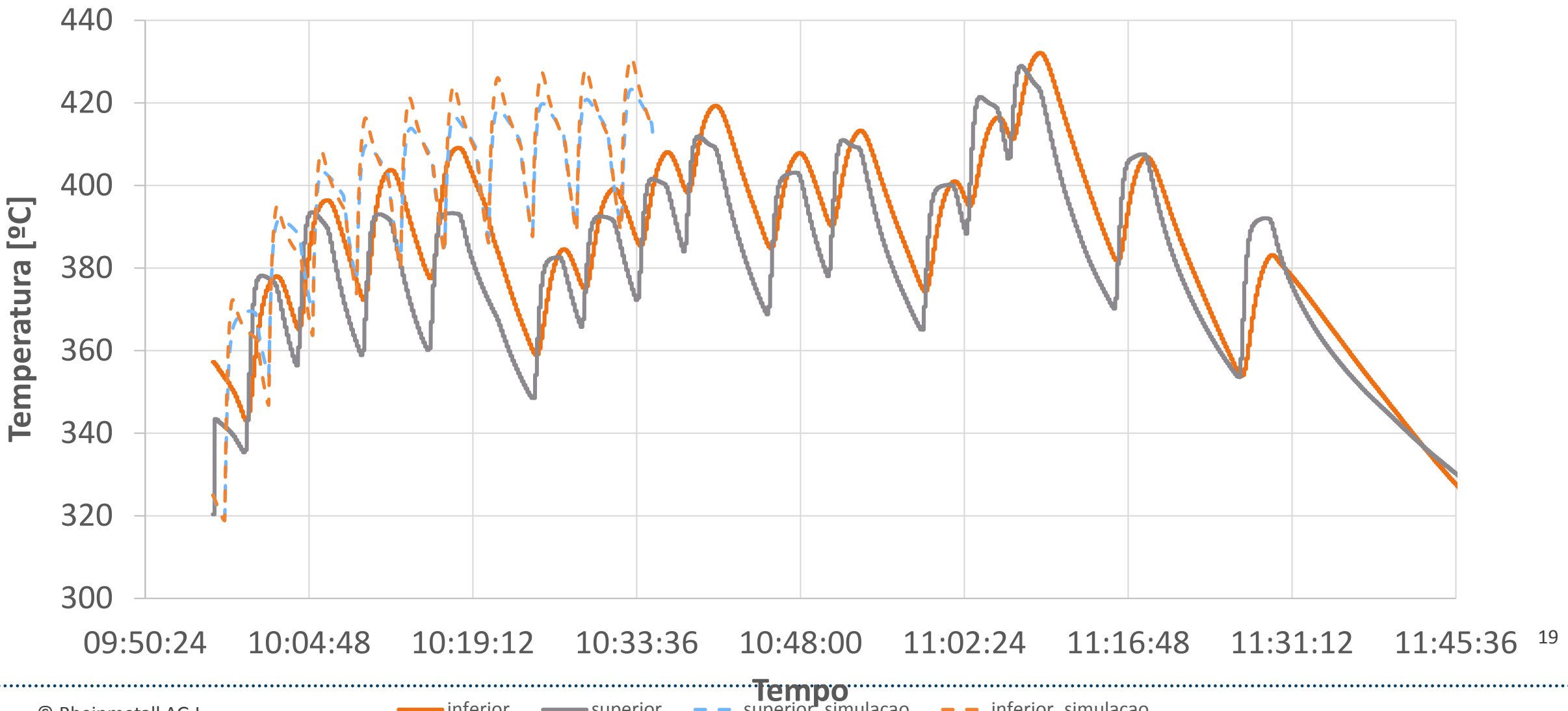
Suporte MAGMA – Desenvolvimento do projeto

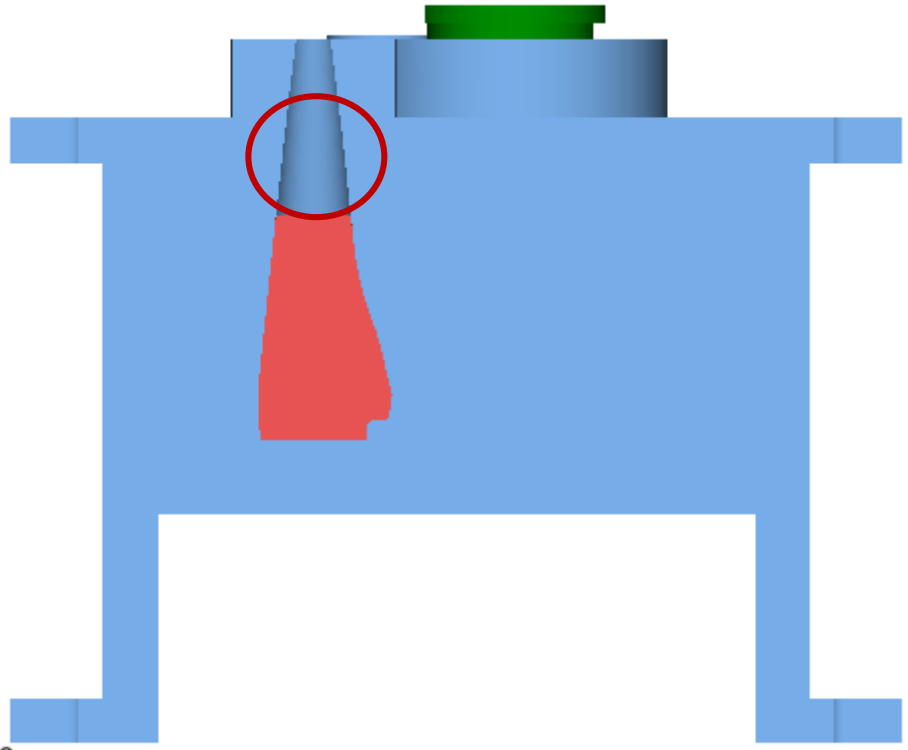
- ***Ajustes da simulação com suporte Magma***



Suporte MAGMA – Desenvolvimento do projeto

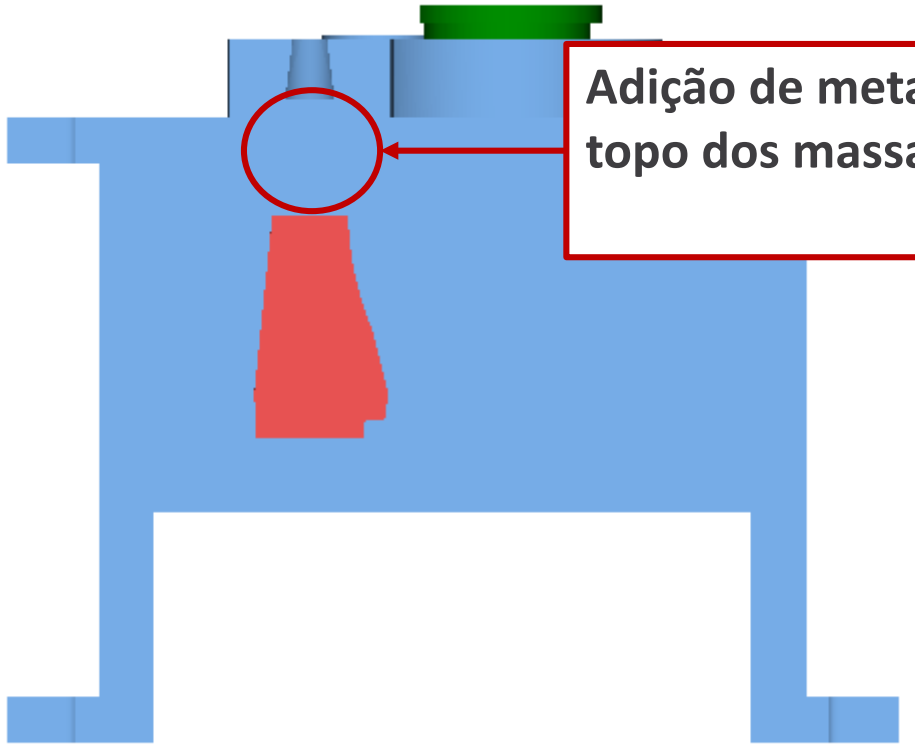
- ***Ajustes da simulação com suporte Magma***

Versão original



v08
Geometry

Versão alterada

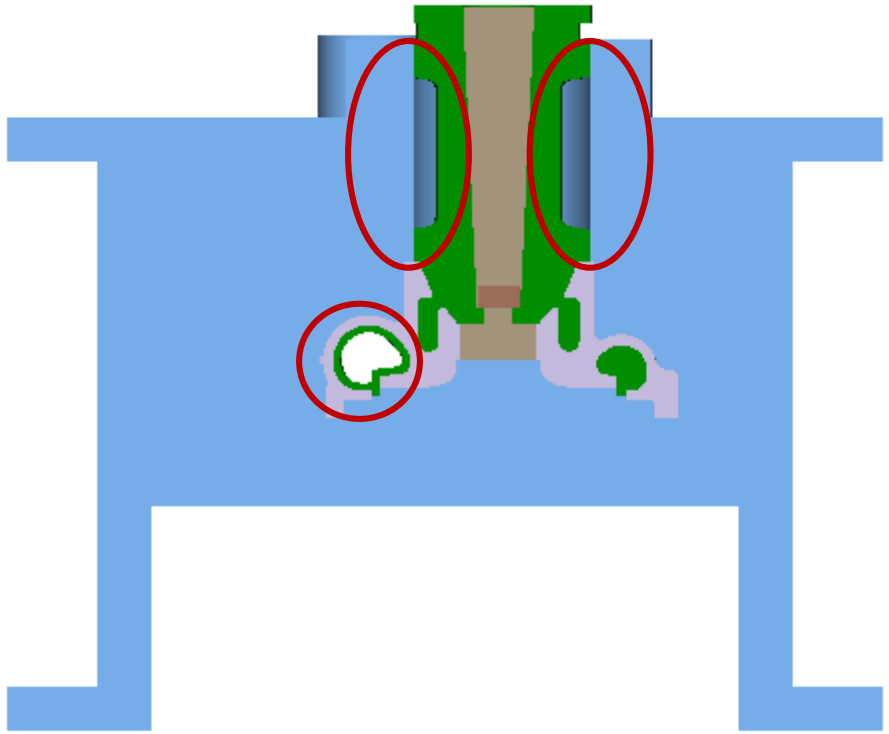


v14
Geometry

Suporte MAGMA – Desenvolvimento do projeto

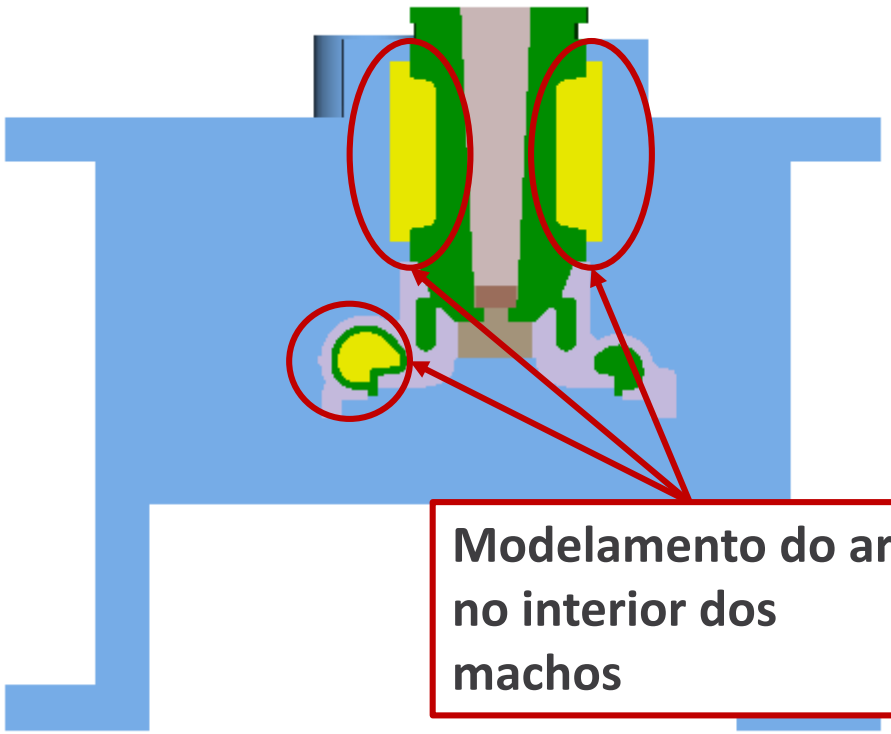
- ***Ajustes da simulação com suporte Magma***

Versão original



v08
Geometry

Versão alterada



v14
Geometry

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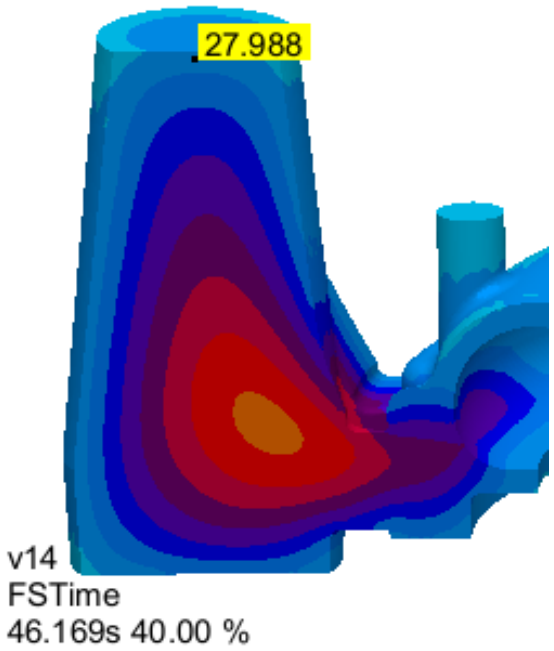
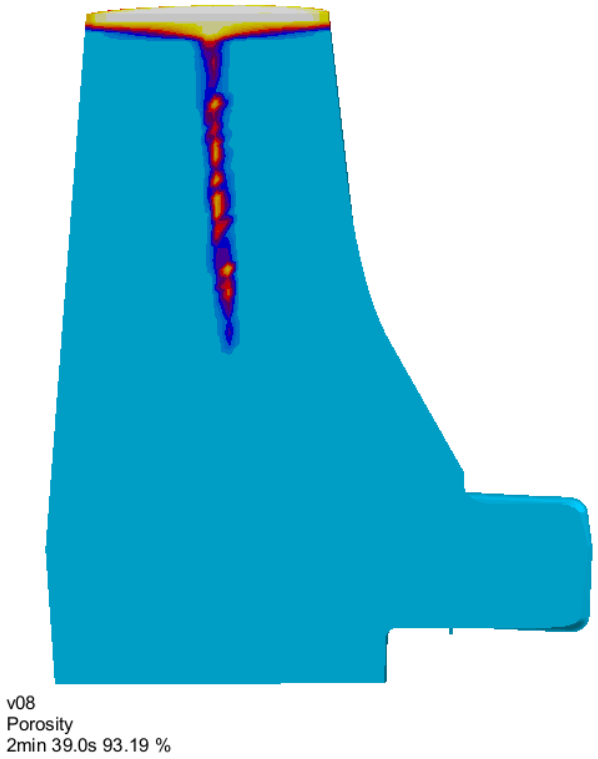
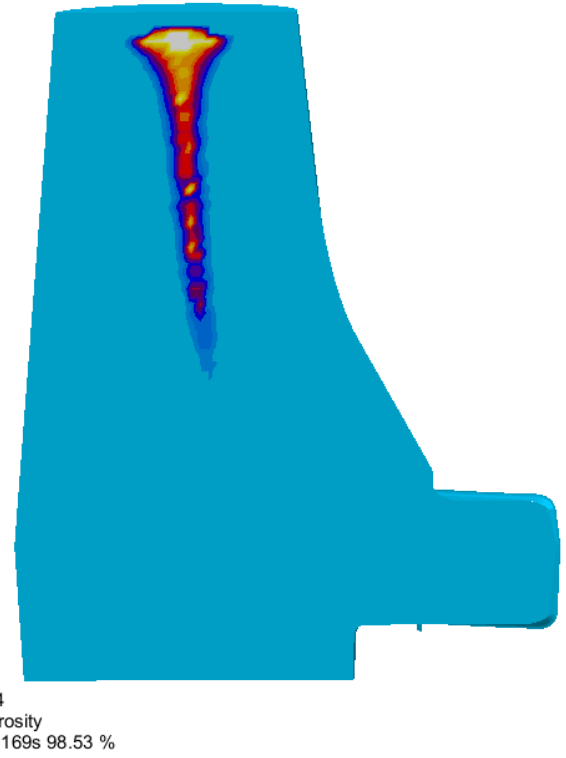
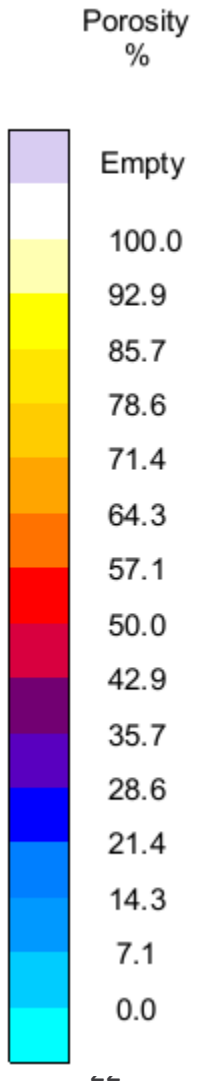
Versão original

Versão simulada pelo suporte Magma









O topo do massalote solidifica antes do corte da alimentação, assim sendo não existe a possibilidade do metal descer para alimentar a região do produto com massa liquida isolada.

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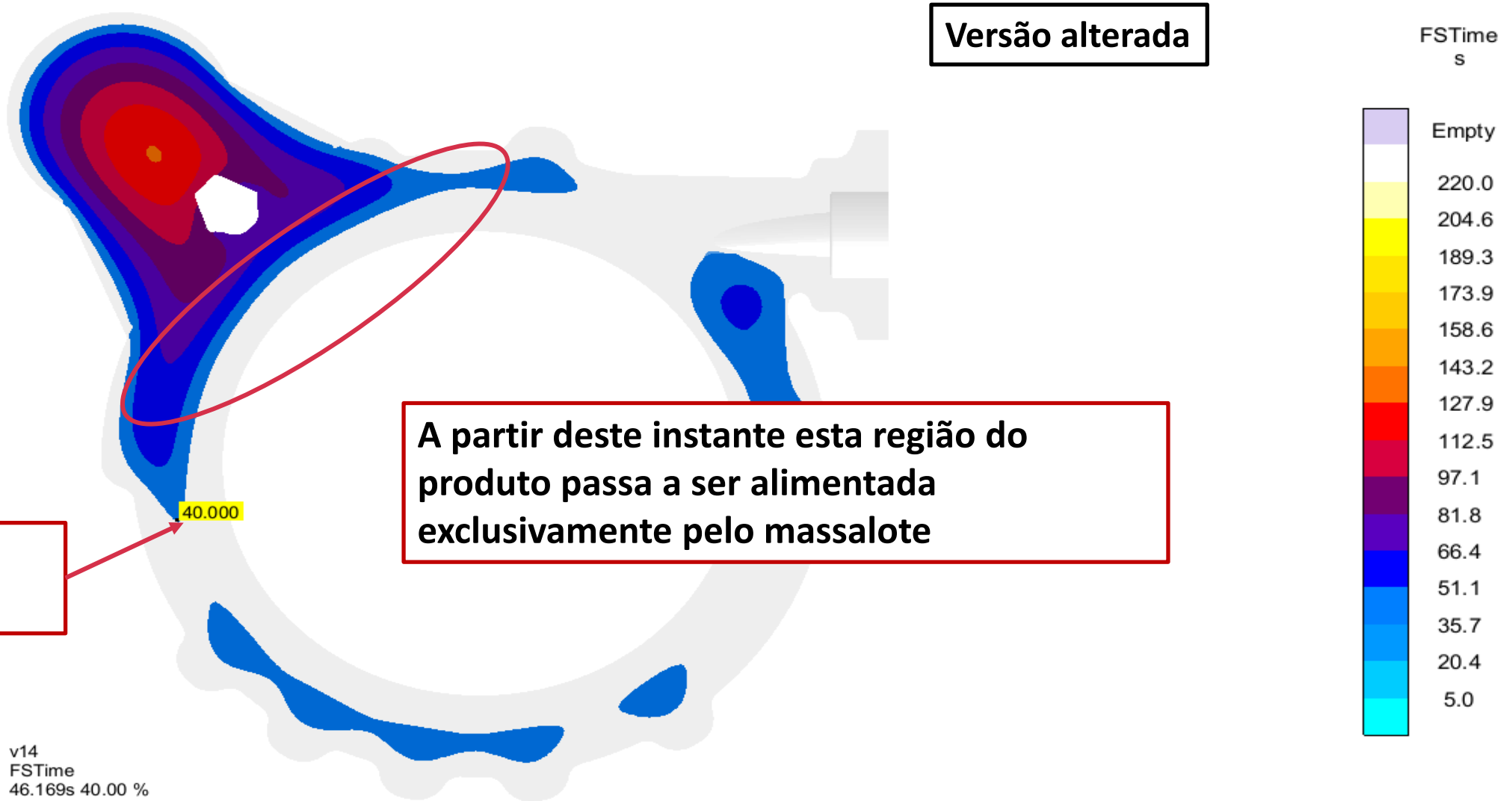
Análise de Resultados – FSTime

Versão alterada



Corte da alimentação

A partir deste instante esta região do produto passa a ser alimentada exclusivamente pelo massalote

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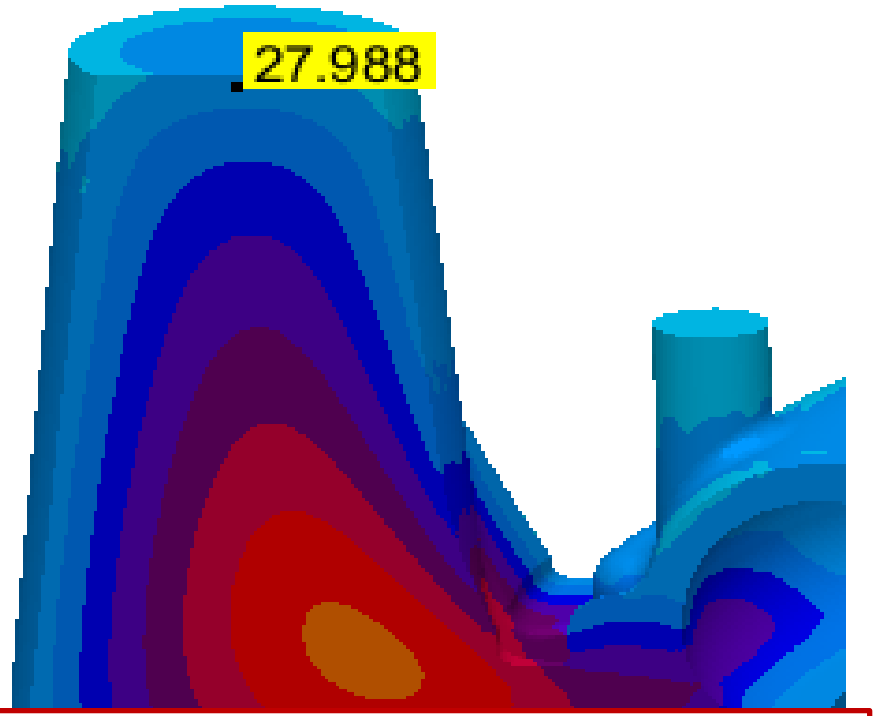
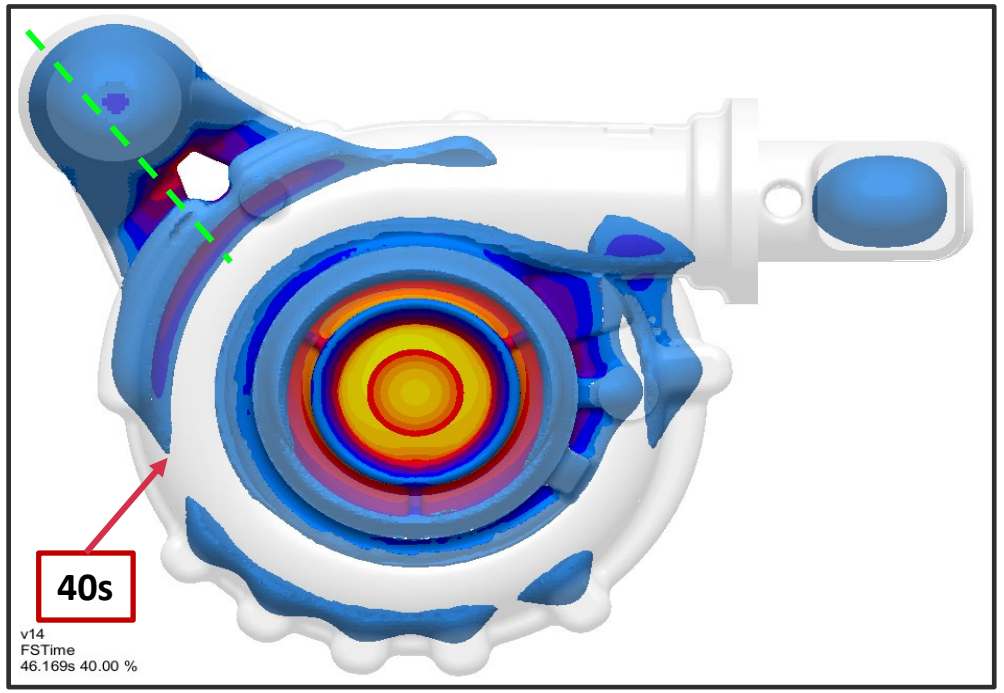
Análise de Resultados – FSTime

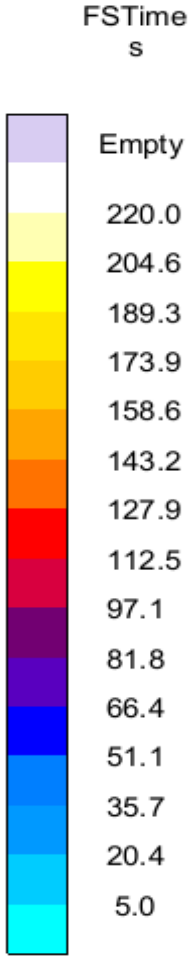


O topo do massalote solidifica antes do corte da alimentação, assim sendo não existe a possibilidade do metal descer para alimentar a região do produto com massa liquida isolada.

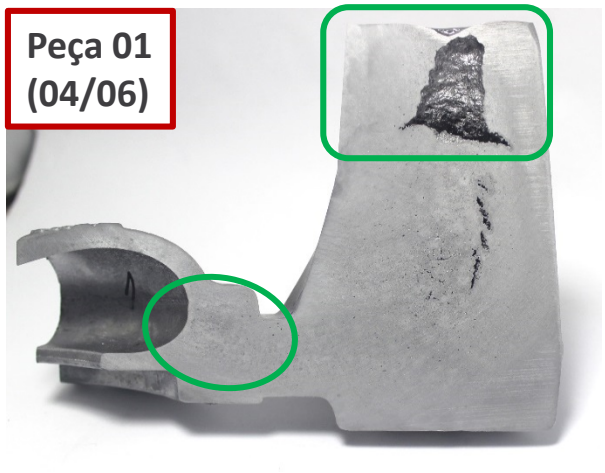
Versão alterada

Realizando-se um corte na região do massalote

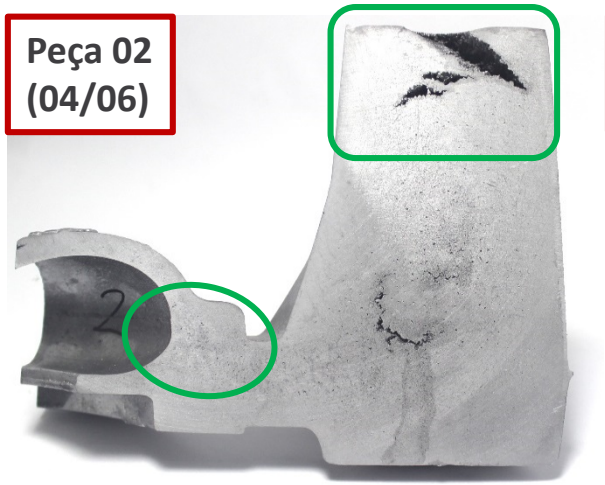




Peça 01
(04/06)

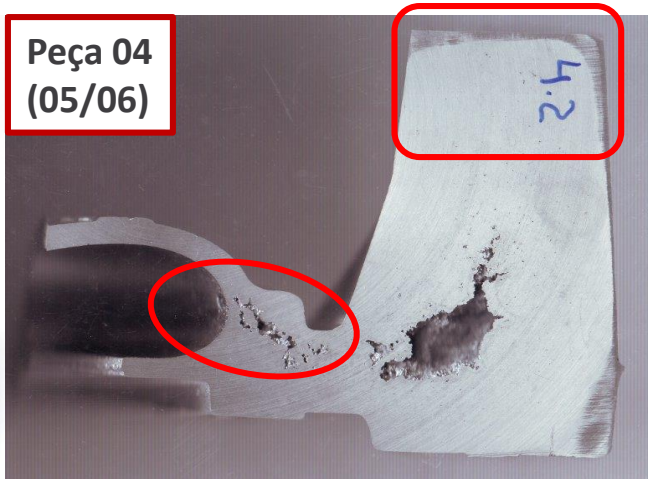


Peça 02
(04/06)

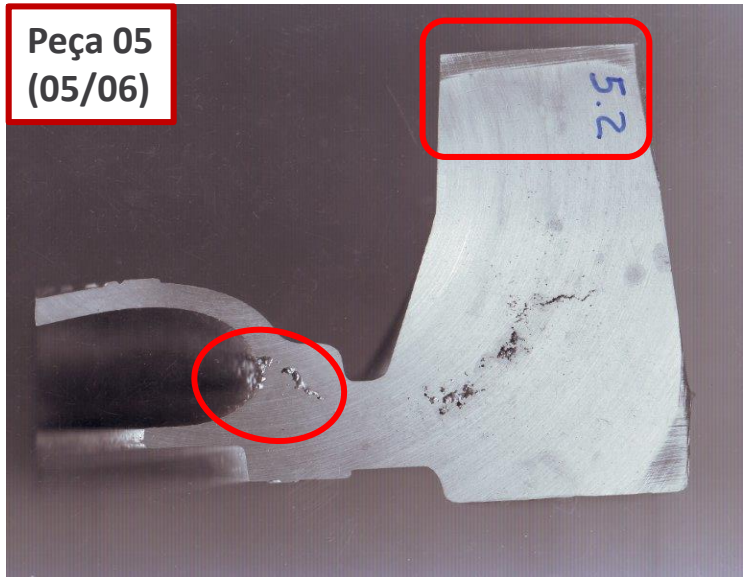


Peça 03
(04/06)

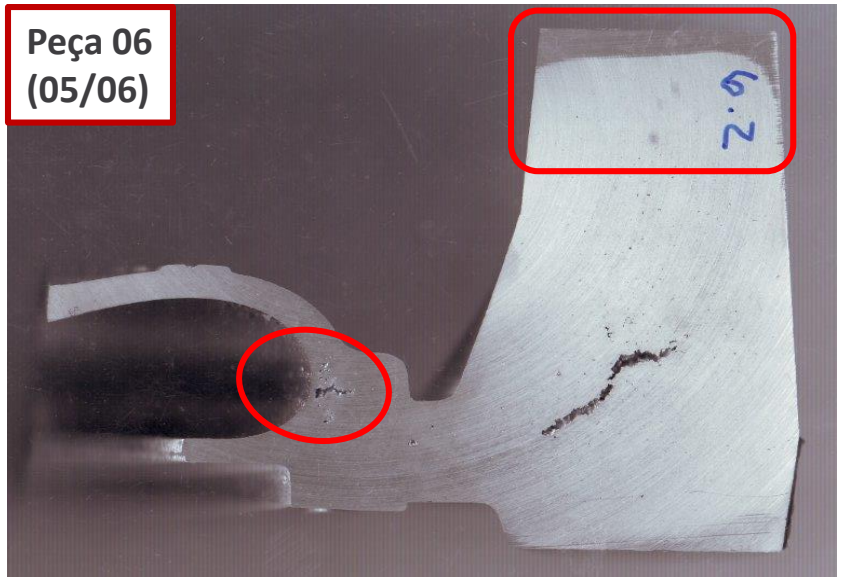
Peça 04
(05/06)



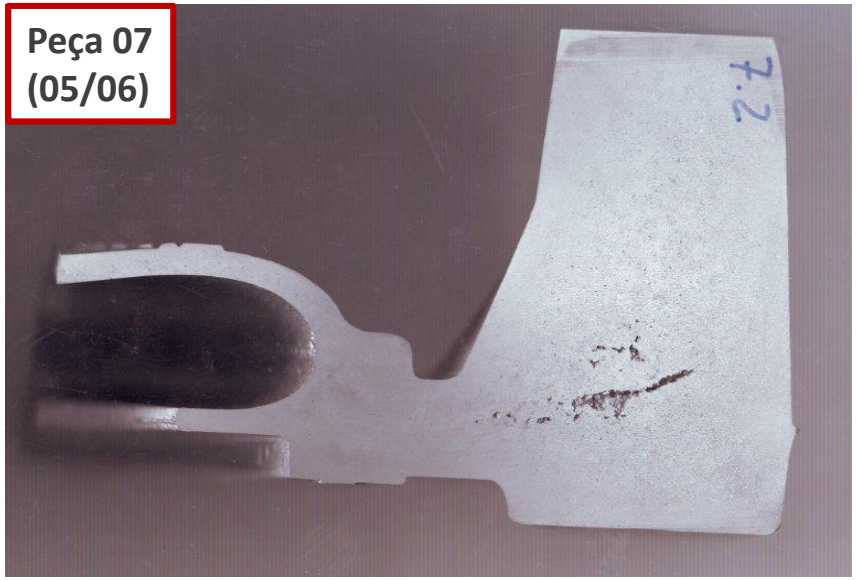
Peça 05
(05/06)

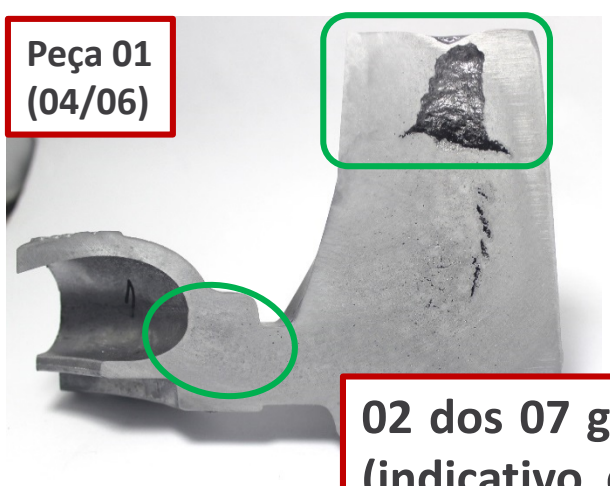


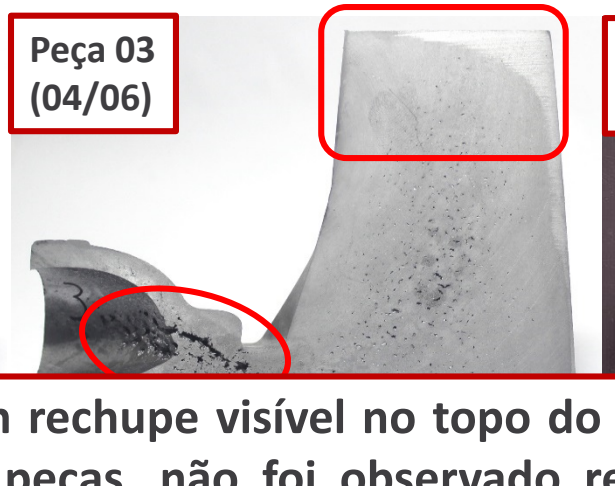
Peça 06
(05/06)

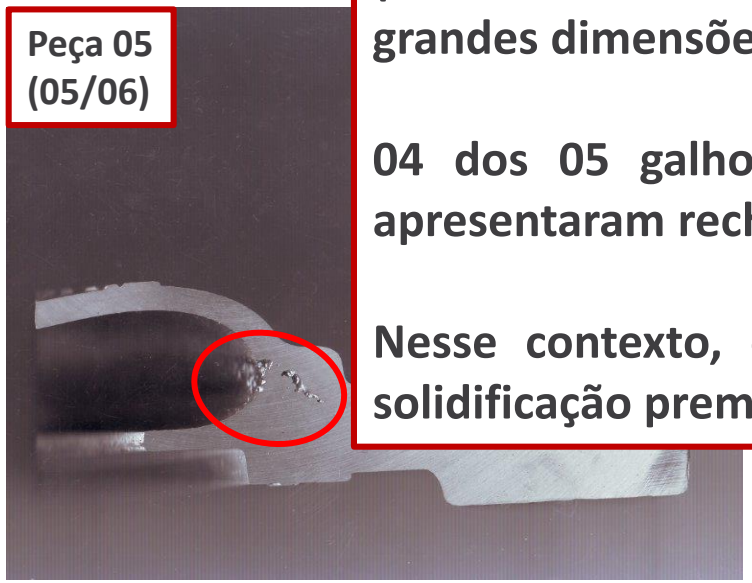


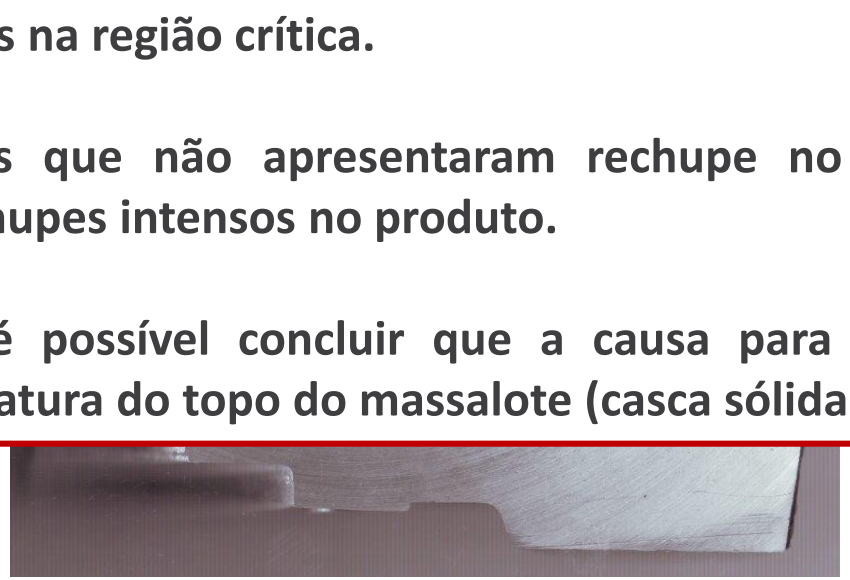
Peça 07
(05/06)

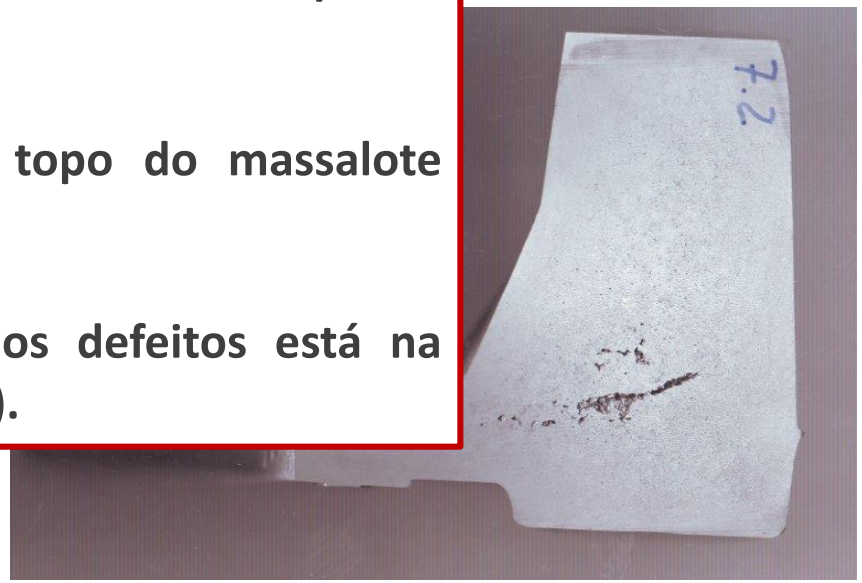








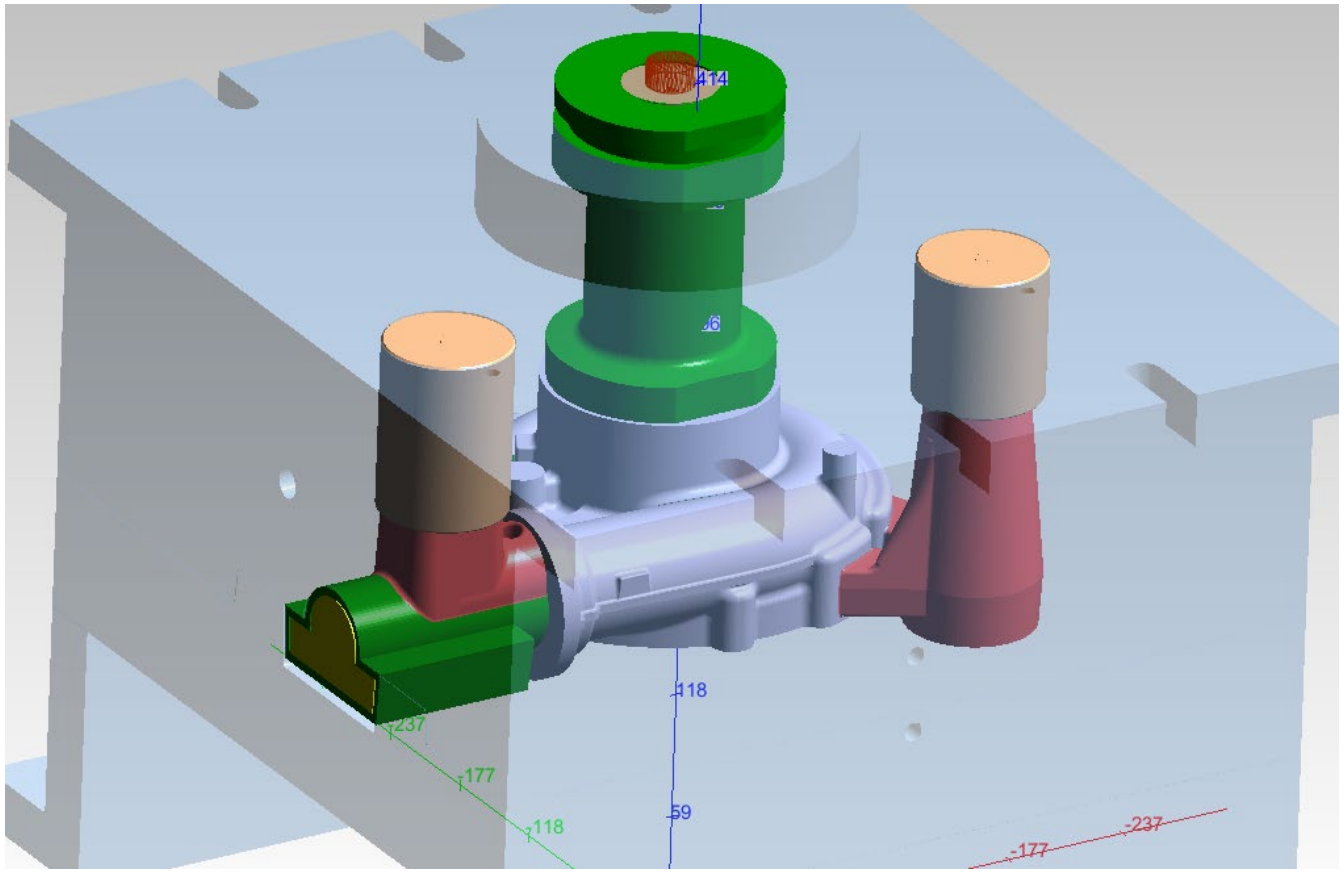




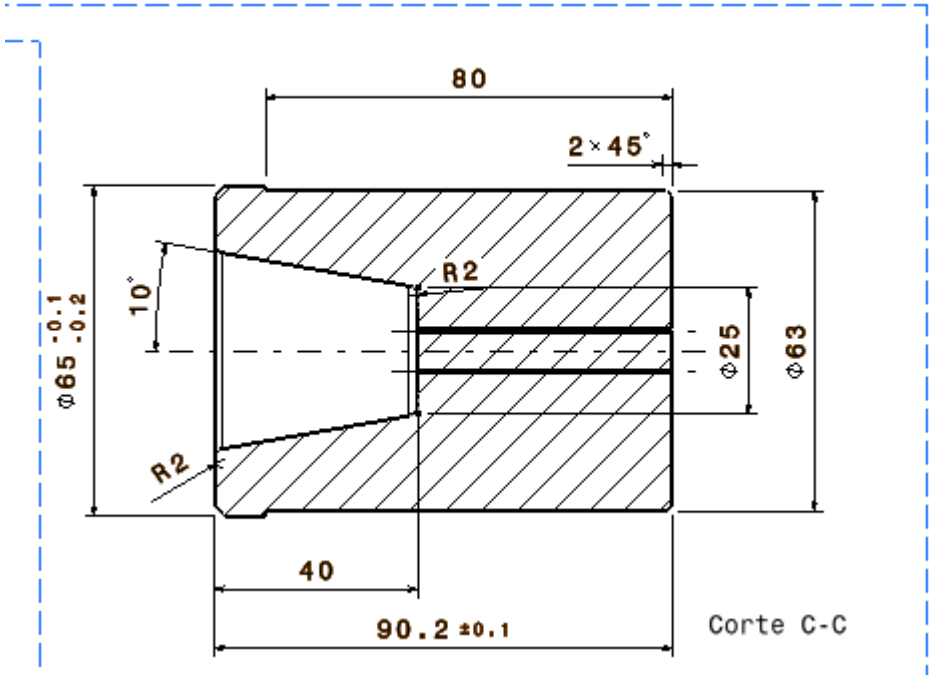
02 dos 07 galhos cortados apresentaram rechupe visível no topo do massalote (indicativo de funcionamento). Nessas peças, não foi observado rechupe de grandes dimensões na região crítica.

04 dos 05 galhos que não apresentaram rechupe no topo do massalote apresentaram rechupes intensos no produto.

Nesse contexto, é possível concluir que a causa para os defeitos está na solidificação prematura do topo do massalote (casca sólida).



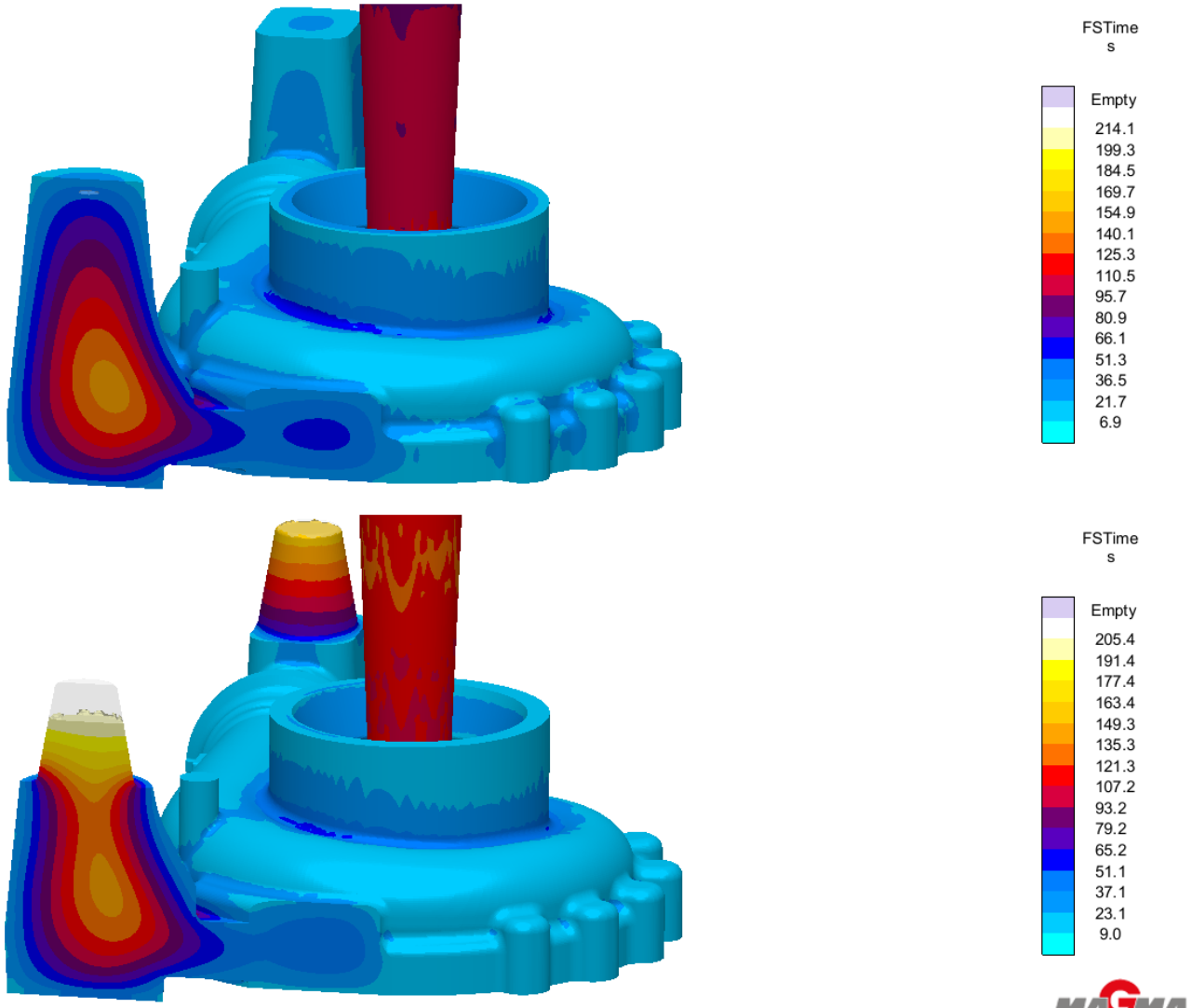
Proposta:
Adicionar monolites no topo dos massalotes



KOLBENSCHMIDT
RHEINMETALL AUTOMOTIVE

Simulação apresentou significativa melhora na atuação do massalote

Adição de material refratário no topo do massalote possibilitou uma melhor atuação
Eliminando os defeitos apresentados nesta região



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Simulação apresentou significativa melhora na atuação do massalote

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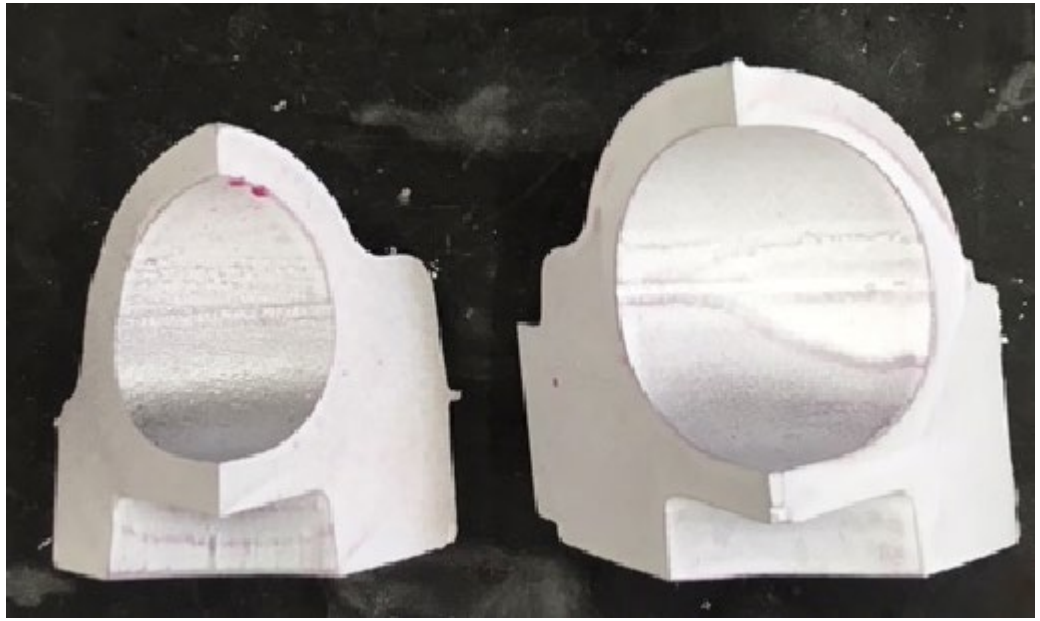
Simulação apresentou significativa melhora na atuação do massalote

Antes das alterações

Após as alterações



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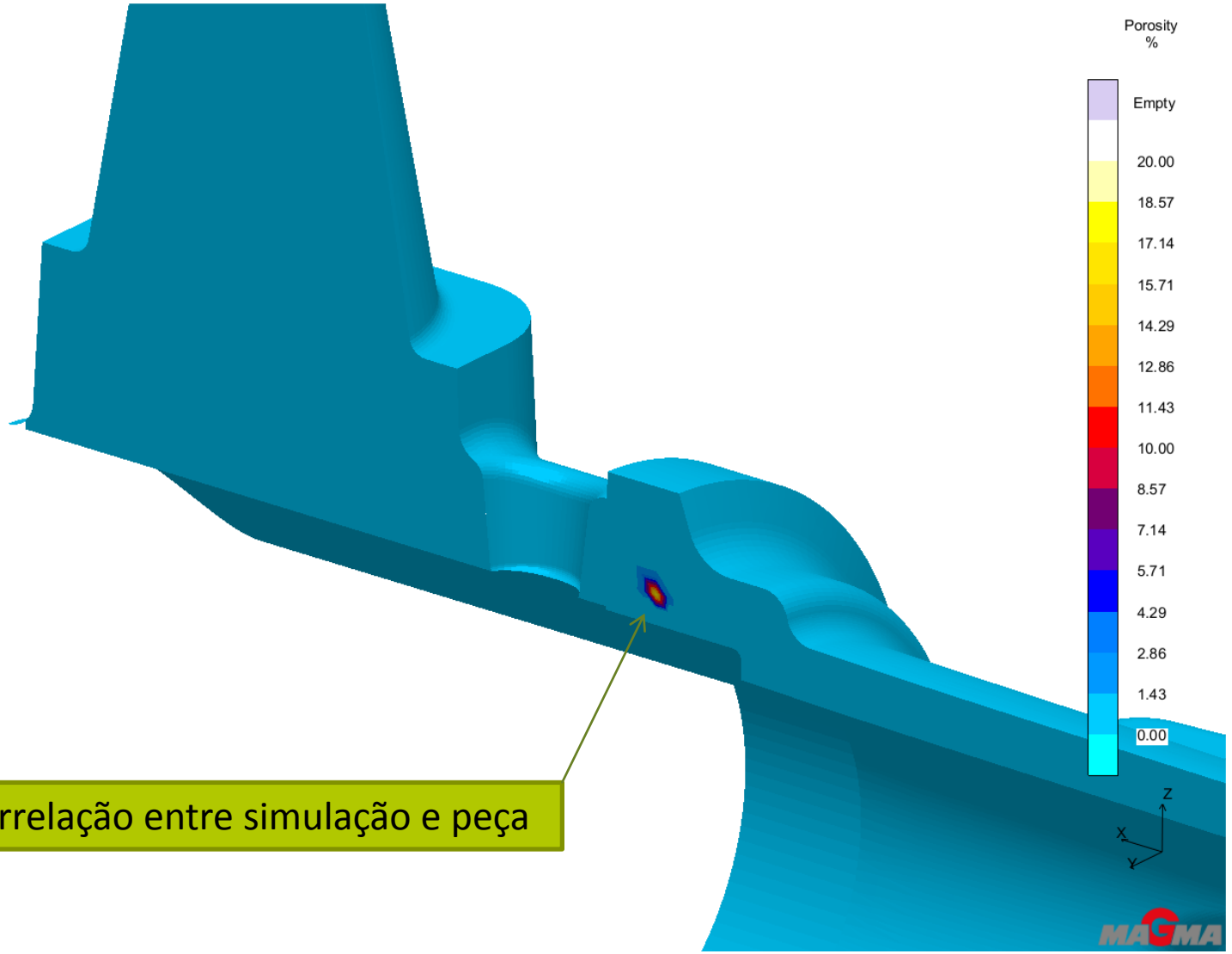

Correlação entre simulação e peça

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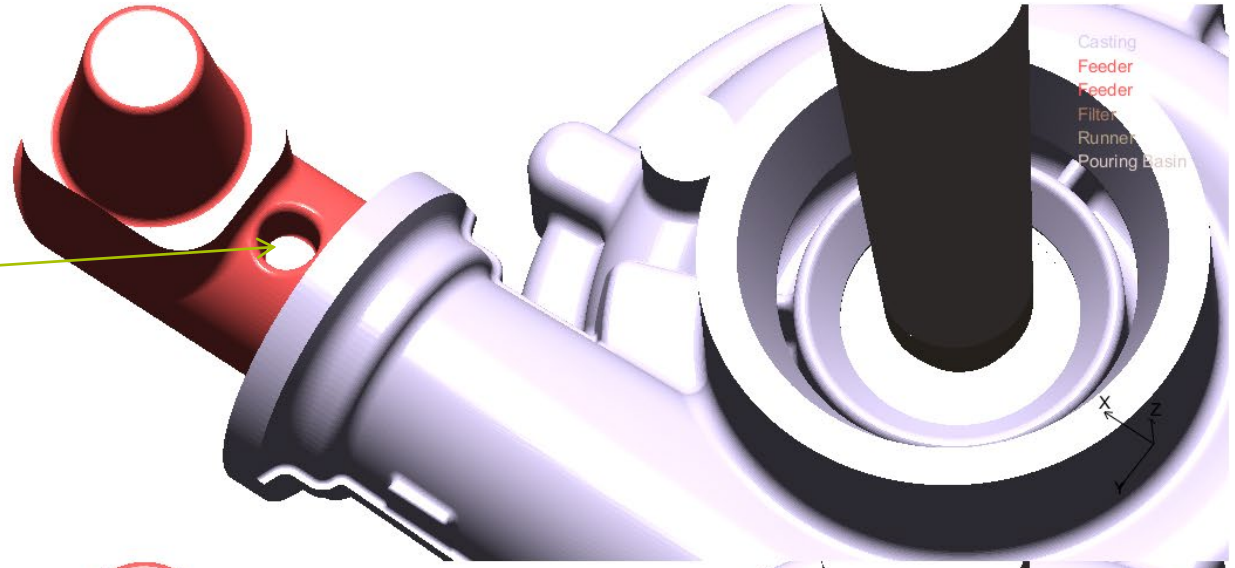
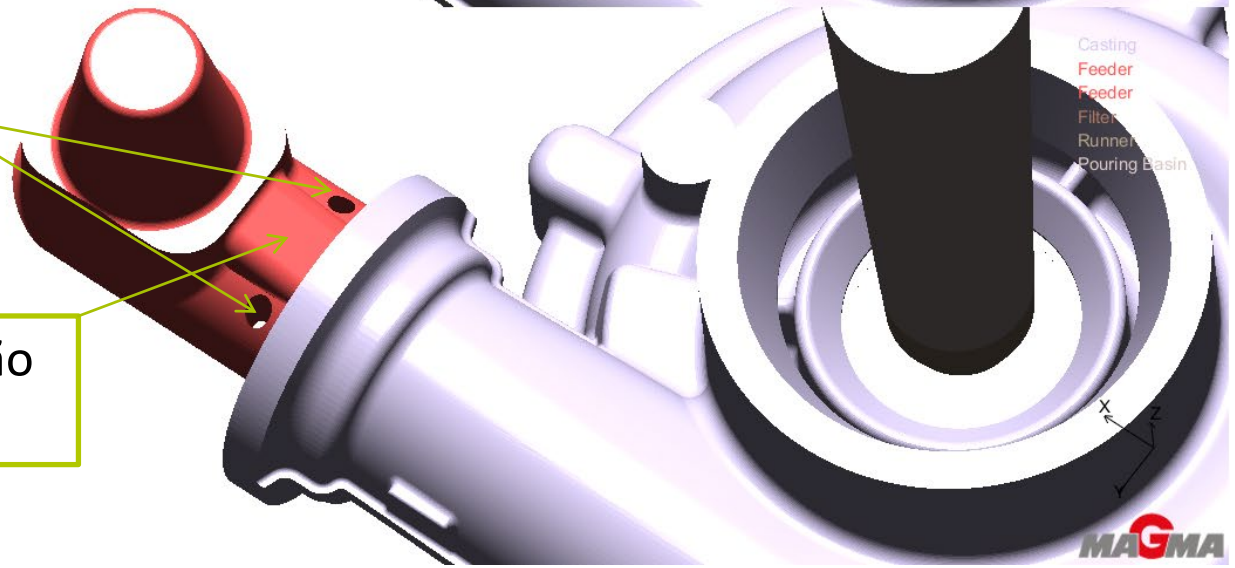
Pino de apoio para macho obstruía alimentação
Na região onde apareceu o defeito



v15
Geometry

Solução foi transferir o pino central para dois pinos laterais

Isso possibilitou aumentar a espessura para alimentação da peça naquela região



v18
Geometry

KOLBENSCHMIDT
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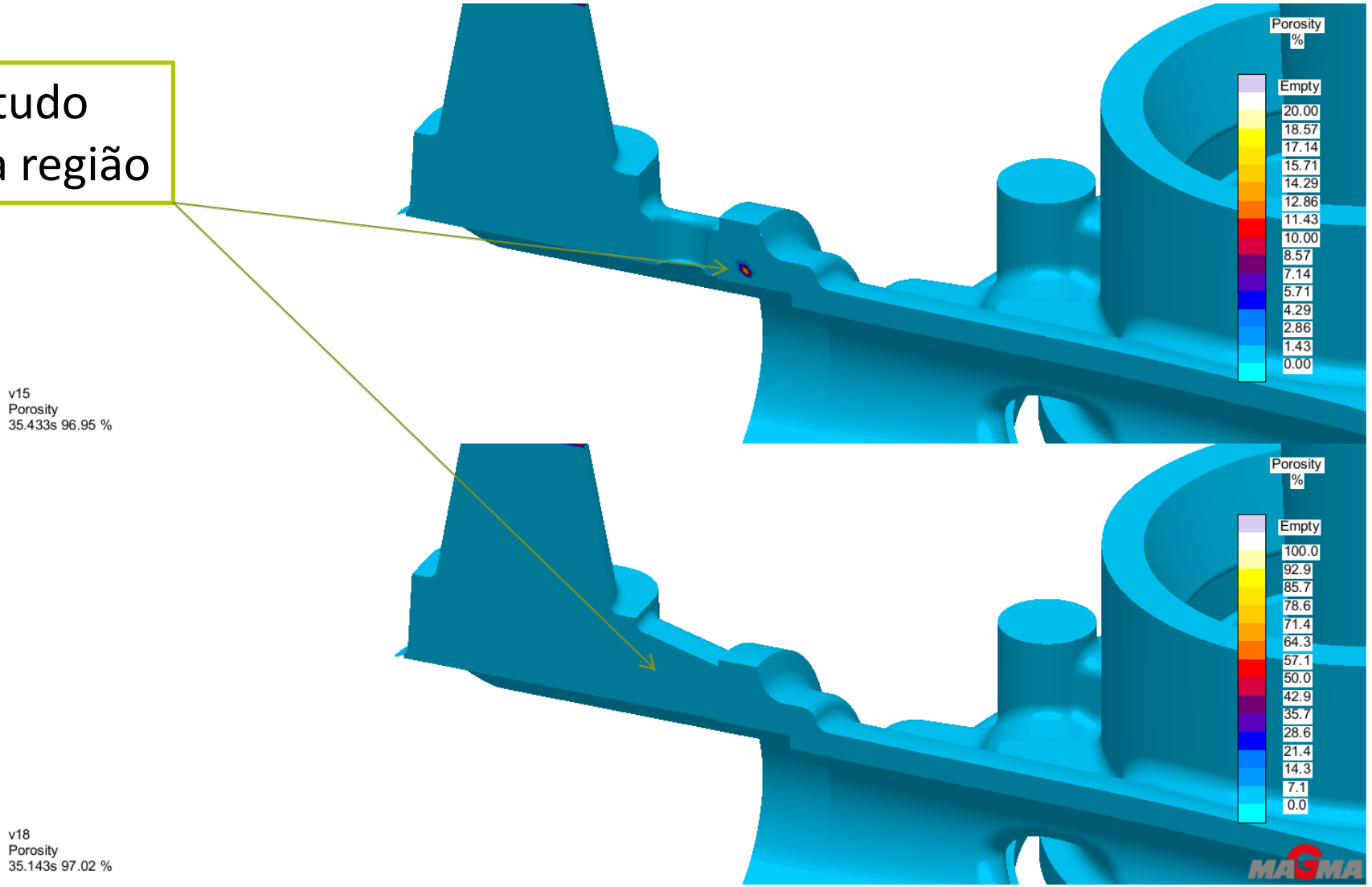
Simulação confirmou o estudo eliminando a tendência na região



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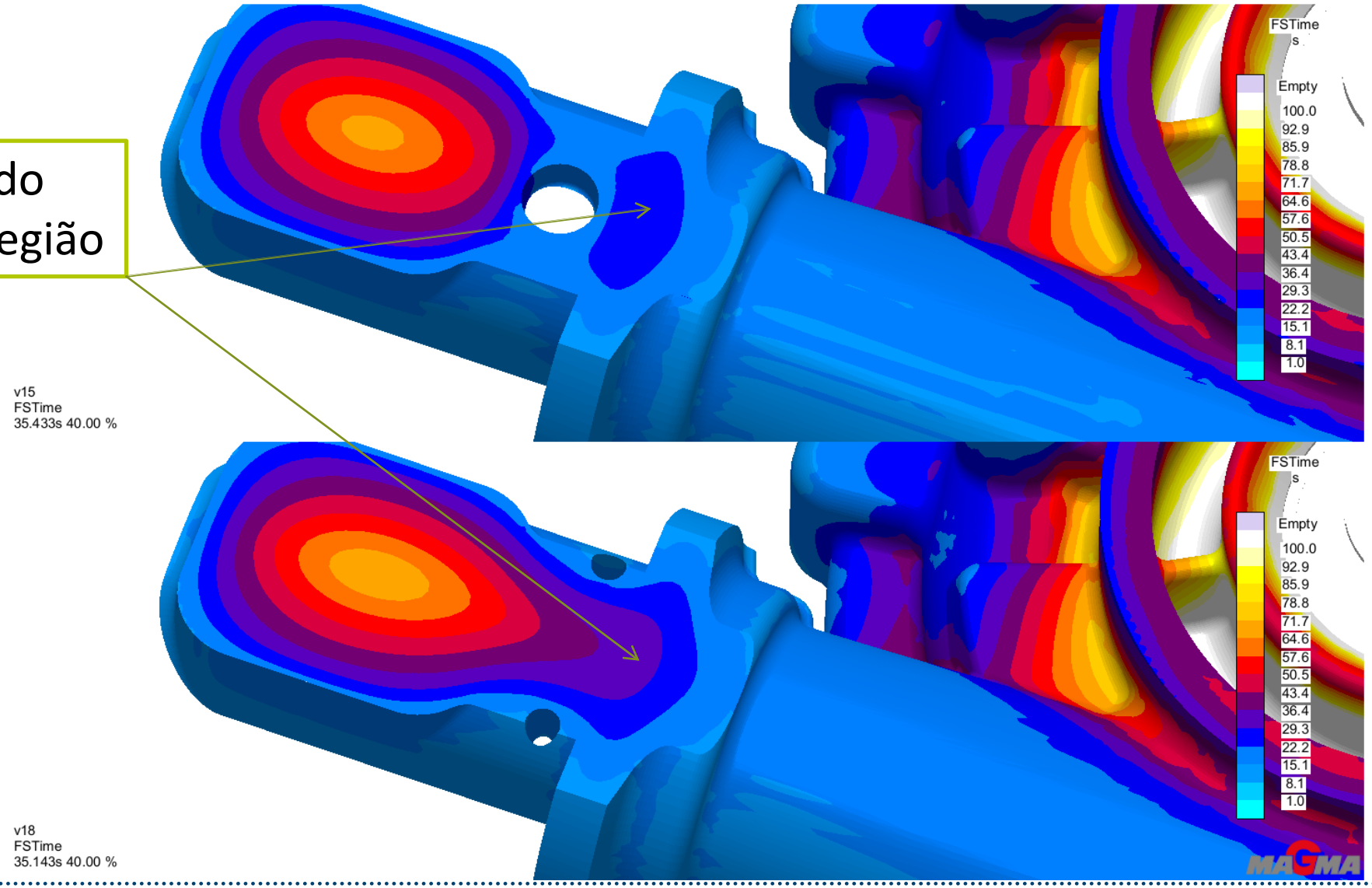
Simulação confirmou o estudo eliminando a tendência na região



OUR HEART BEATS FOR YOUR ENGINE.

THANKS