ArcelorMittal

Deux exemples pour le calcul haute performance

Modélisation de procédé: Phénomènes très non-linéaires , couplés

Optimisation multi-critére: Chainage d'opération, contraintes « locales » et optimisation globale.

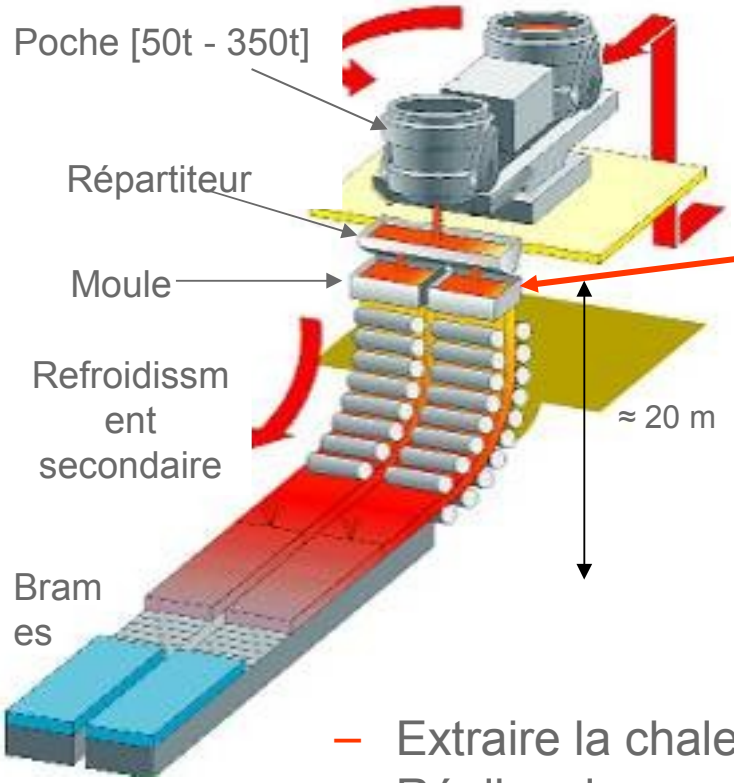
François Mudry – Directeur Scientifique

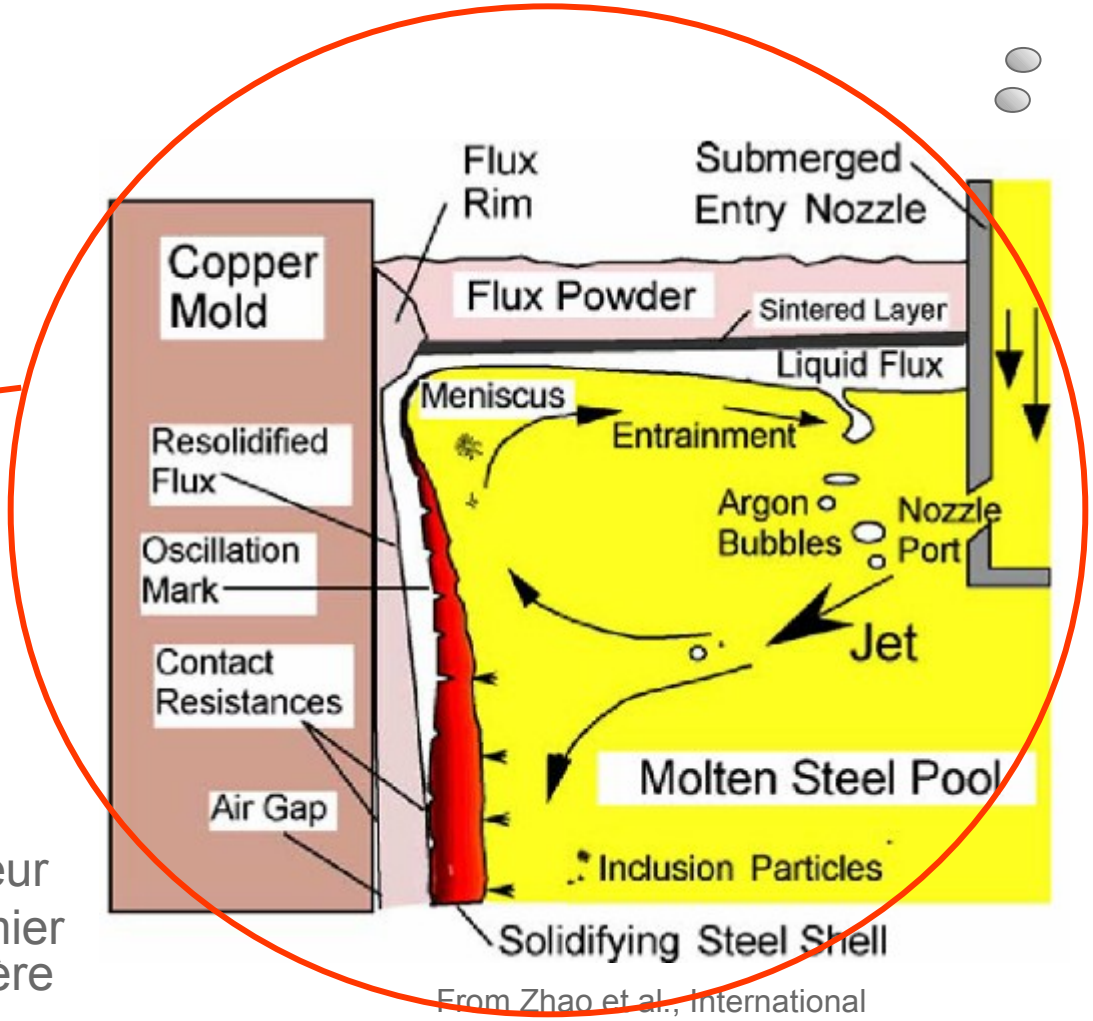
Exemple 1: La coulée continue

ArcelorMittal

Solidification en continue de l'acier liquide (1500°C)

Nombreux phénomènes complexes





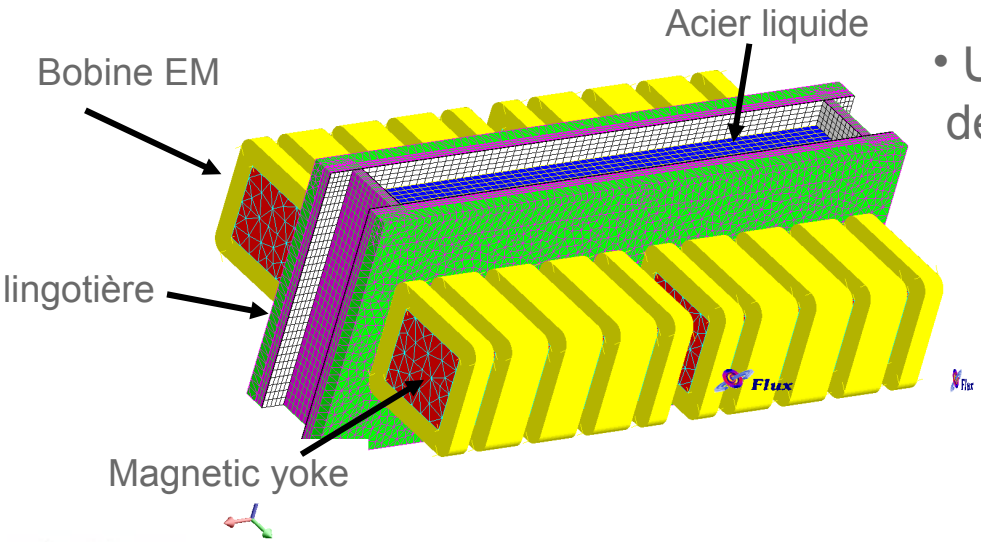
- Extraire la chaleur
- Réaliser le premier produit de la filière

From Zhao et al., International Journal of Heat and Fluid Flow 26 (2005) 105–118

® ArcelorMittal – All rights reserved for all countries
Cannot be disclosed, used, or reproduced without prior written specific authorization of ArcelorMittal
CONFIDENTIAL – Restricted Information – ArcelorMittal proprietary information

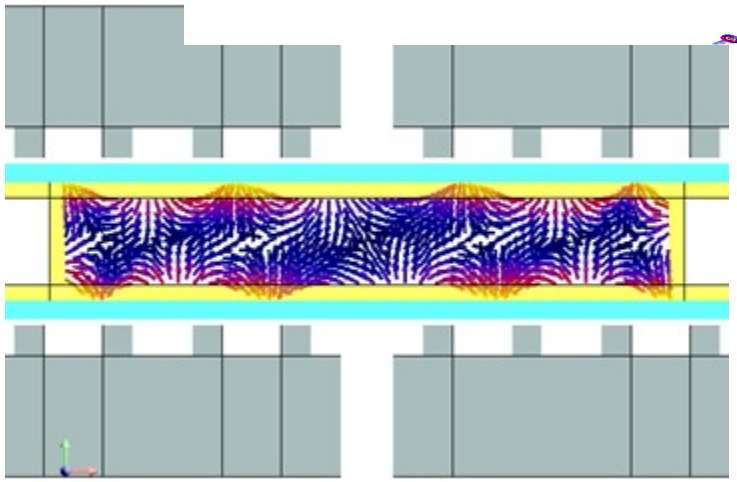
On ajoute l'électromagnétisme, en couplage fort avec la dynamique des fluides

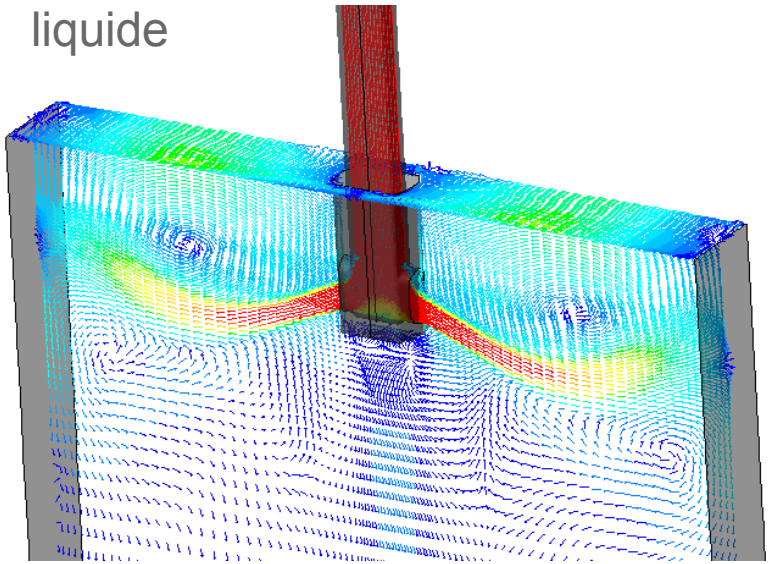
ArcelorMittal



- Une aide essentielle à l'optimisation de la régulation

Evaluation de l'effet la régulation électromagnétique sur l'acier liquide





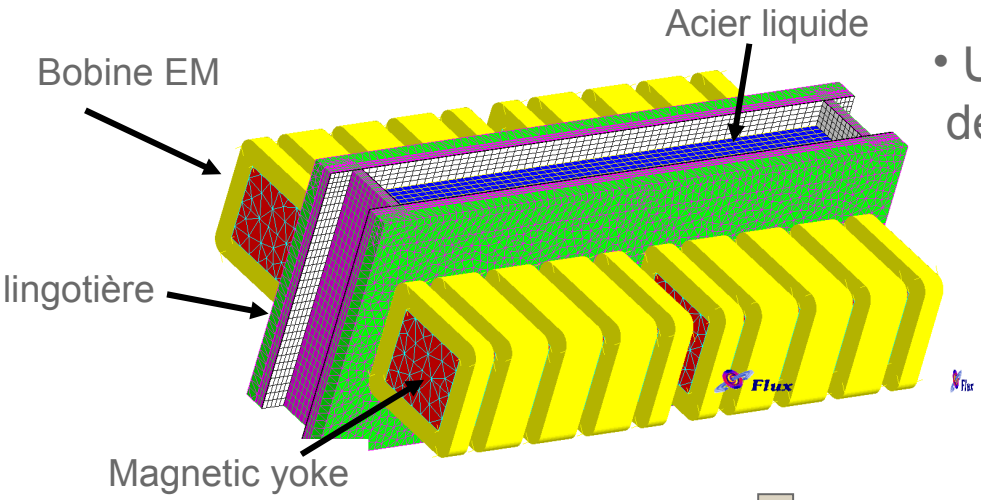
Force électromagnétique en mode rotatif

Et le liquide va se solidifier sur les faces et .....

® ArcelorMittal – All rights reserved for all countries
Cannot be disclosed, used, or reproduced without prior written specific authorization of ArcelorMittal
CONFIDENTIAL – Privileged Information - ArcelorMittal proprietary information

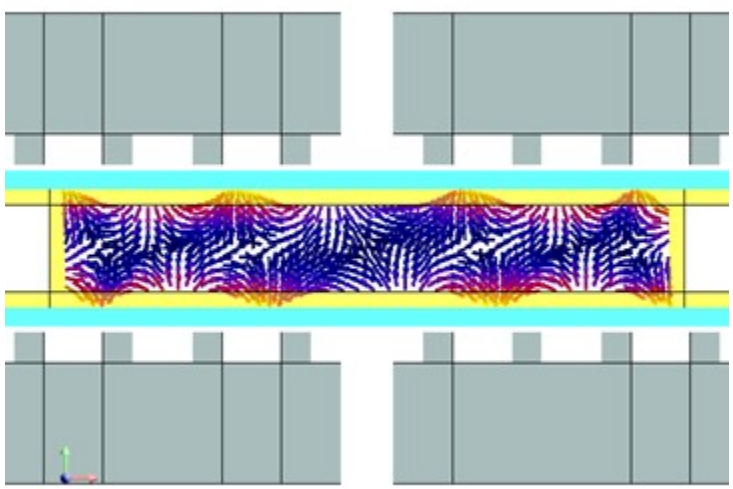
On ajoute l'électromagnétisme, en couplage fort avec la dynamique des fluides

ArcelorMittal

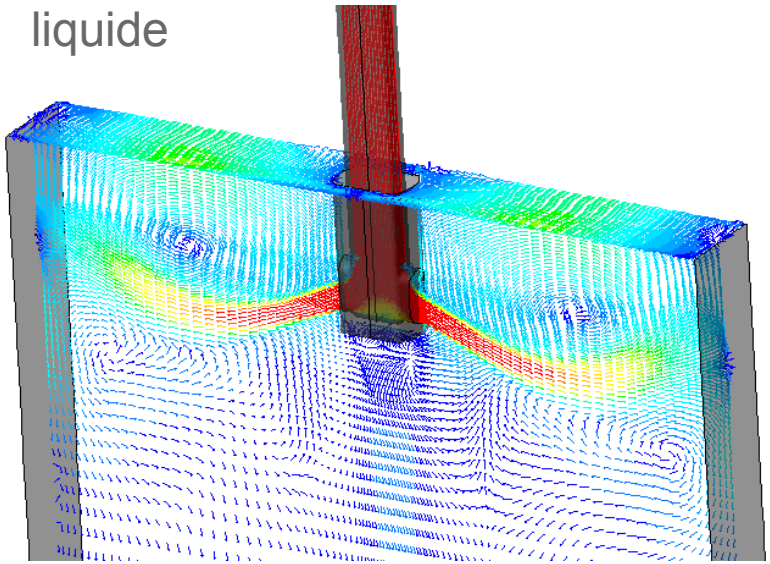


- Une aide essentielle à l'optimisation de la régulation

Evaluation de l'effet la régulation électromagnétique sur l'acier liquide



Force électromagnétique en mode rotatif

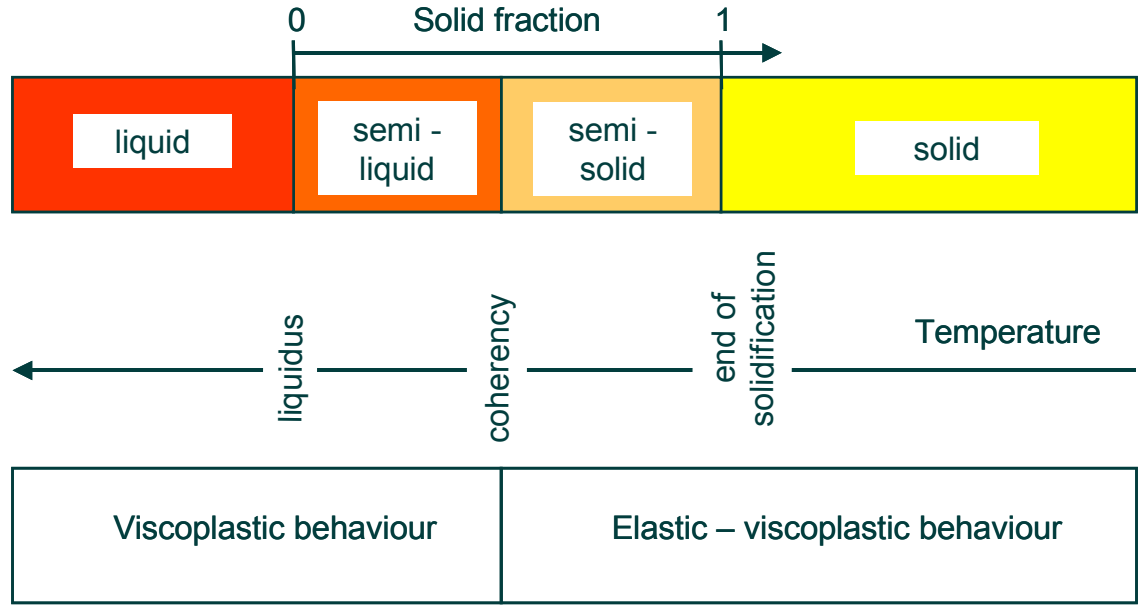


Et le liquide va se solidifier sur les faces et .....

® ArcelorMittal – All rights reserved for all countries
Cannot be disclosed, used, or reproduced without prior written specific authorization of ArcelorMittal
CONFIDENTIAL – Privileged Information - ArcelorMittal proprietary information

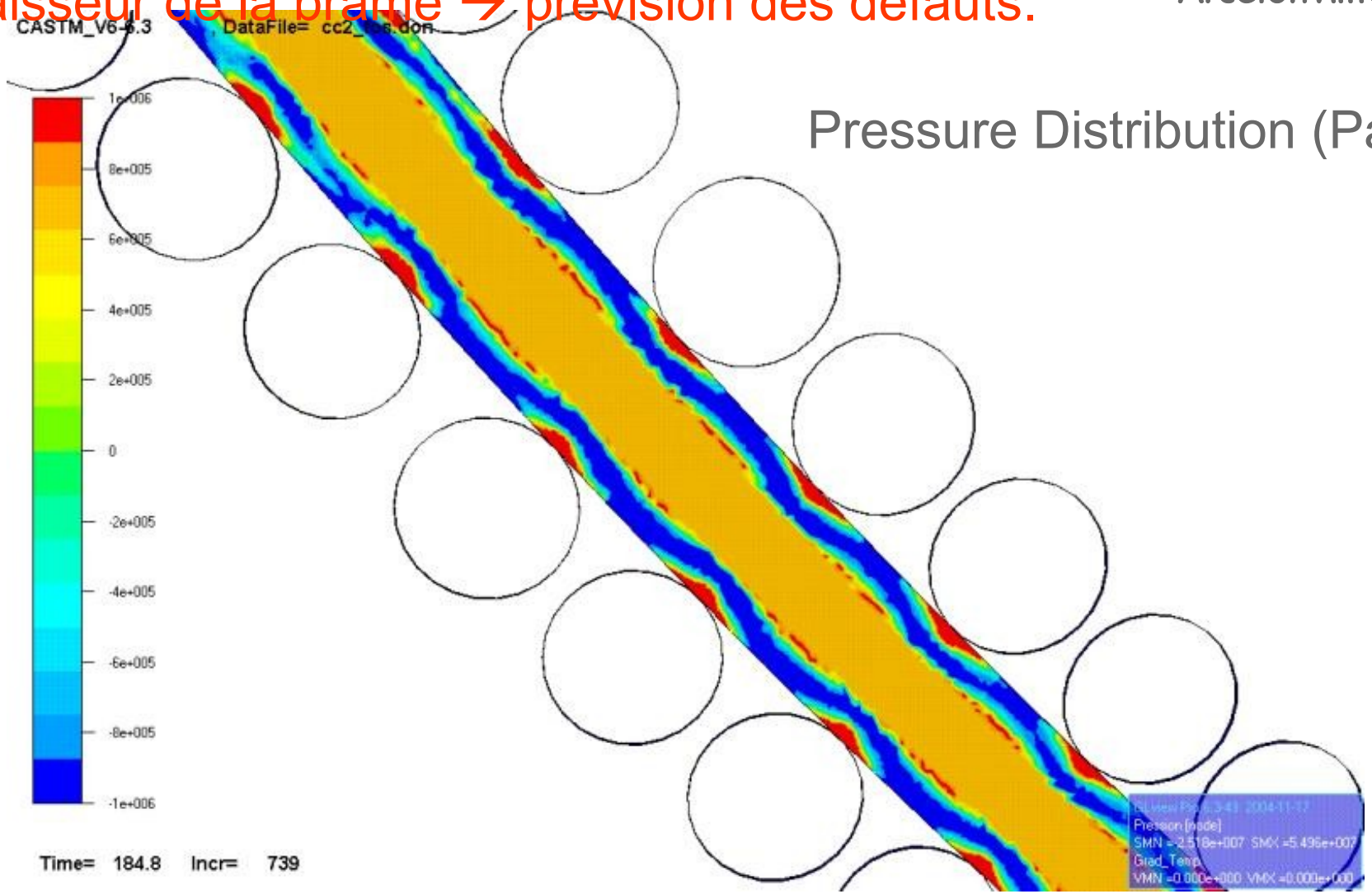
On va l'extraire à létat semi-solide.... Simulation thermo-mécanique

- Simulation thermomécanique.
- A la suite de la simulation précédente
- Simlulation de la solidification



® ArcelorMittal – All rights reserved for all countries
Cannot be disclosed, used, or reproduced without prior written specific authorization of ArcelorMittal
CONFIDENTIAL – Privileged Information - ArcelorMittal proprietary information

On cherche à avoir la distribution des contraintes dans l'épaisseur de la brame → prévision des défauts.

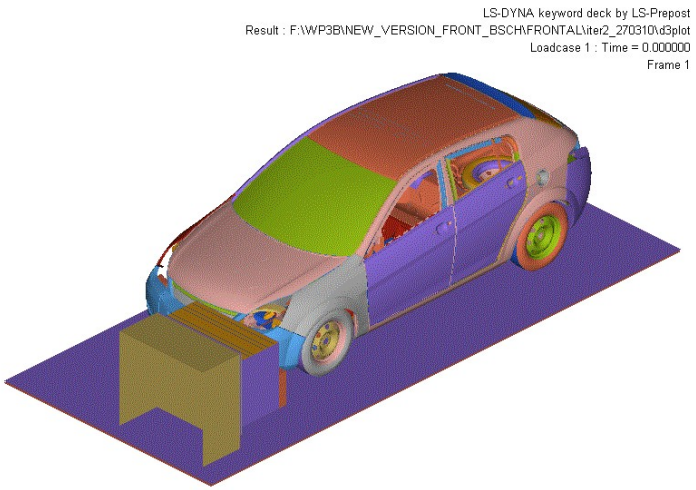


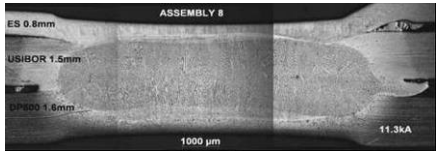
-→ On ne sait pas tout coupler et vraiment paralléliser.

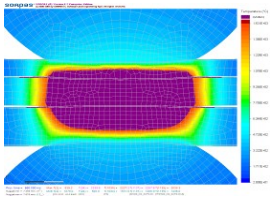
® ArcelorMittal – All rights reserved for all countries
Cannot be disclosed, used, or reproduced without prior written specific authorization of ArcelorMittal
CONFIDENTIAL – Privileged Information - ArcelorMittal proprietary information

Exemple 2. réduction de poids d'un véhicule en utilisant de nouveaux aciers.

- Des centaines de pièces
- Beaucoup de contraintes à respecter:
  - Performance en crash (4 configurations de crash)
  - Comportement en rigidité (flexion, torsion)
  - modes de vibration dans la bonne zone
  - faisabilité de l'emboutissage des pièce
  - Faisabilité de l'assemblage (y.c. la fatigue..,
- Optimisation: des milliers de configurations testées.
  - De la masse
  - Et du coût….





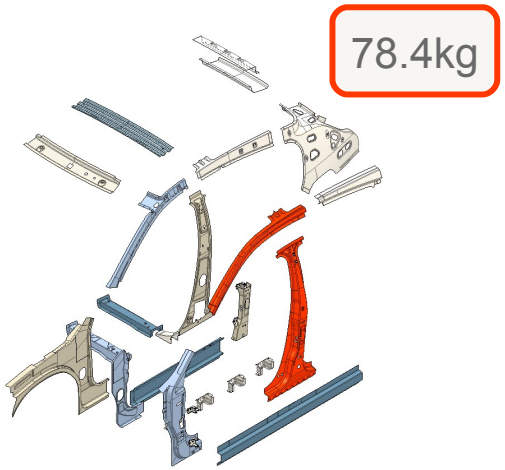


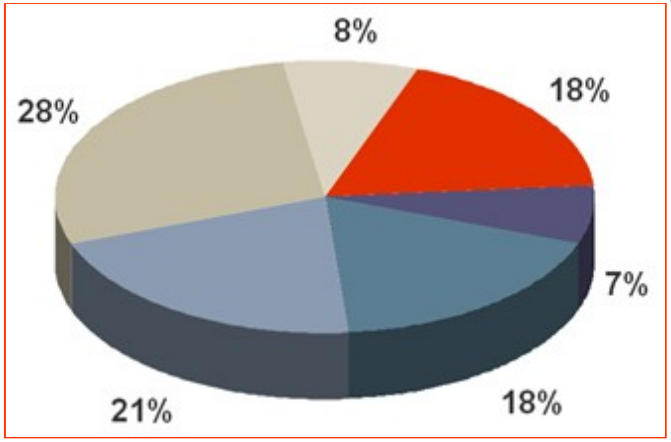
Une configuration représente des dizaines d'heure de calcul sur des machines parraléles (> 100 Cœurs)

® ArcelorMittal – All rights reserved for all countries
Cannot be disclosed, used, or reproduced without prior written specific authorization of ArcelorMittal

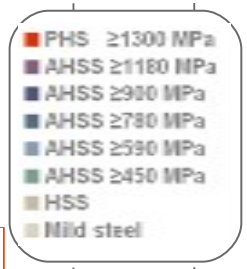
Acier Haute Résistance comme solution d'allégement - (1Kg = 30 000 t de CO2 par an sur le parc français)

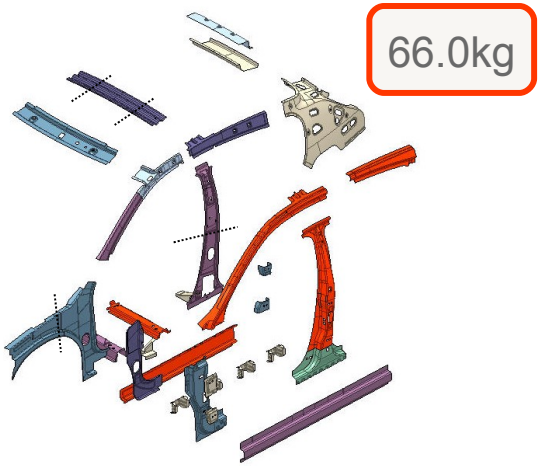
® ArcelorMittal – All rights reserved for all countries
Cannot be disclosed, used, or reproduced without prior written specific authorization of ArcelorMittal
CONFIDENTIAL – Privileged Information - ArcelorMittal proprietary information

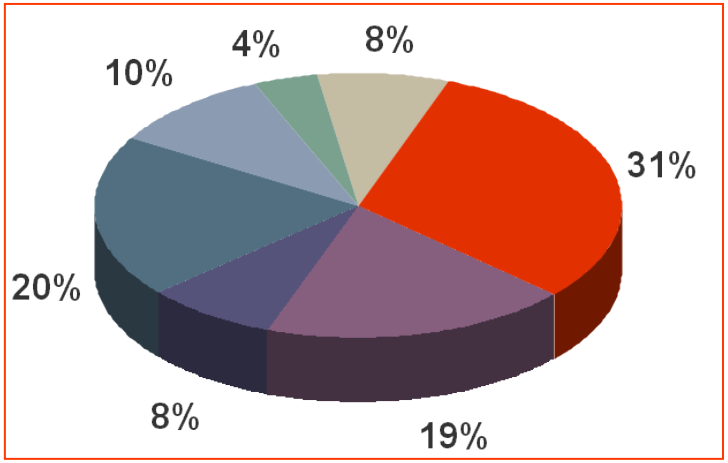




Modèle de référence







Solution optimisée