

35th INTERNATIONAL CAE CONFERENCE AND EXHIBITION

THE ENGINEERING SIMULATION PATH TO DIGITAL TRANSFORMATION

Vicenza, ITALY | 2019, 28 - 29 OCTOBER

Vicenza Convention Centre @Fiera di Vicenza

Optimization of the Piston cooling oil jet using Particleworks with modeFRONTIER

David Percival – EnginSoft UK

Rod Giles – Royal Enfield

Royal Enfield - History

- Longest established motorcycle company with continuous production - since 1901
 Premium motorcycles to premium
 - Redditch, UK 1901 1970
 - Chennai, India 1955 present
- Part of Eicher Group since 1994
- Fastest growing motorcycle brand
 - 30,000 units in 2005
 - 720,000 units in 2018-19

Premium motorcycles top growth chart in Motown Royal Enfield Says Will Retain Market Leadership

RUYAI EIIIIEIU SAYS VVIII RELAIII IVIAI

Chennai: India's love for lifestyle biking has led to the 250 cc and abo ve motorcycle segment clocking the highest growth in the auto industry. At over 31% growth in the just concluded fiscal - a rate of growth higher than the top gear UV market — this segment is now worth 6,76,227 units, up from 5,15,448 units in FY15-16. In contrast, the overall motorcycle and step through market grew at a modest 3.68% clip in FY16-17. Higher engine displacement motorcycles now comprise 6% of the total motorcycle and step through market, up from 4.8% in FY15-16. Of course, the lion's share of



Background

ENGINSOFT ROYAL ENFIELD

- Royal Enfield is working on the LS410 engine for the Himalayan bike
- Adequate cooling of the Piston is essential in Engine design
- A poorly cooled Piston will warp over time affecting the lifetime and reliability of the bike



Problem



No way of calculating oil distribution or cooing effect

- Rely on physical testing and hardness analysis
 - Inaccurate results poor reliability
 - Increases time to Market
 - Decreases profits

"How can we be sure the piston will not overheat and warp?"

ROYAL ENFIELD







www.caeconference.com

2019, 28 - 29 October 35th INTERNATIONAL CAE CONFERENCE AND EXHIBITION

Initial Simulation

www.caeconference.com



CAD **Model Build** Simulation



Results – HTC Mapping







HeatTransferCoefficient [W/(m^2K)] 10000.0

www.caeconference.com

Drainage Flowrate



Drainage Flowrate



Initial project - Conclusions

- Using Particleworks we are able:
 - Calculate the HTC distribution of the oil jet
 - Calculate the flowrate of oil draining out of the piston to the cylinder

- This allows Royal Enfield to identify issues during the design process
 - Saving time and money during physical testing and prototypes

ADDED VALUE PROJECT

www.caeconference.com

2019, 28 - 29 October 35th INTERNATIONAL CAE CONFERENCE AND EXHIBITION

Simulation Led Design

Design
$$\Longrightarrow$$
 \bigoplus \Longrightarrow \bigoplus \Longrightarrow Prototype

Design
$$\Rightarrow$$
 \overrightarrow{mF} \Rightarrow \overrightarrow{OP} \Rightarrow \overrightarrow{OQ} \Rightarrow Prototype

Particleworks - modeFrontier

- A Particleworks API was created by EnginSoft
 UK
- The node introspects the Particleworks model and finds all parameters we can vary
- Parameters are dragged into the GUI and modeFRONTIER modifies the model and launches pre-processing, solver and postprocessing



Simulation time reduction

 Mappings averaged over an entire cycle are identical throughout simulation



Simulation time reduction

- Mappings averaged over an entire cycle are identical throughout simulation
- Flowrate though drainage holes is uniform throughout simulation
- Hence we are able to shorten the length of the simulation to only 2 cycles (0.016s)
 - Simulation time can be reduced to 15-20 minutes



Design Modifications



Workflow



Results

www.caeconference.com

2019, 28 - 29 October

35th INTERNATIONAL CAE CONFERENCE AND EXHIBITION

www.caeconference.com

THANK YOU FOR YOUR ATTENTION

www.caeconference.com

2019, 28 - 29 October 35th INTERN

35th INTERNATIONAL CAE CONFERENCE AND EXHIBITION