Epiroc Accurately Models Acoustic Performance of Mining Equipment using ESI's VA One

Challenge

Epiroc found that the use of acoustic measurements late in the design cycle to assess the performance of proposed engine noise encapsulation designs resulted in costly iterations of physical prototypes. Detailed acoustic investigations early in the design process proved critical to reduce costs and improve design turnaround time.

Benefits

After working with ESI's VA One, engineers at Epiroc found that the use of virtual engineering solutions early in the design process to model acoustic performance resulted in quantifiable savings in terms of time and cost. VA One allowed Epiroc engineers to rank design variants and refine them prior to building expensive prototypes. The use of simulation to illustrate and quantify design performance allowed engineers and managers to confirm strategies early in the design phase, reducing the need for costly engineering changes later on.

"The project proved that ESI's VA One is capable of accurately predicting the vibro acoustic performance of complex designs allowing design engineers to refine proposals before committing to expensive prototypes."

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Noise and Vibration Specialist
Epiroc

Background

Epiroc, a world-leading provider of sustainable productivity solutions focusing on the manufacturing, mining, and construction industries, produces drill rigs for surface and underground mining applications (Fig.1). The noise radiated from one of these drill rig's power generator is of particular concern in environments where operators work in close proximity to the mining equipment. To meet internal noise level targets, absorbent materials are used to encapsulate the engine and reduce noise radiation.

Fig.1: Drill Rig for mining and its power generator

The diesel engine used as the power source is a key contributor to radiated noise from drill rigs. An effective encapsulation of the engine (source) reduces noise, which contributes to the operators' comfort, results in higher productivity and meets upcoming noise regulations.

The design team at Epiroc assessed the performance of different engine encapsulation variants early in the design

cycle in order to identify optimal acoustic performance based on cost, weight and noise reduction. Another objective was to achieve faster design turnaround times.

Initially, they analyzed the acoustic performance of component sets, such as the engine cooler and accompanying baffle. Physical prototypes were tested to understand energy transmission from the engine, through the baffle and to the cooler. Testing was time consuming and expensive due to the countless measurements required and the string of physical prototypes needed to evaluate each new improvement. Another concern was that results were not available until late in the design cycle, when design changes are costly and difficult to implement, as overall design parameters are already set.

Epiroc began working with ESI's vibro-acoustic solution, VA One Statistical Energy Analysis (SEA) module, to assess the use of simulation for optimizing noise radiation for engine encapsulation systems.

SEA is a proven methodology for the assessment of high frequency acoustic behavior. The methodology offers a fast and effective means of simulating high frequency acoustic phenomena by modeling the transfer of energy in coupled subsystems, which can be resolved using power equilibrium equations.

The SEA and measurement validation identified the existing baffle as a particular weak transmission path, that rather than constrained through measurements in the SEA model needed to be modeled using HYBRID modeling. It was found that the use of PEM was needed to model the Transmission Loss (TL) of the baffle correctly in the low frequency region (Fig. 2).

Use of Hybrid modeling allowed designers to assess performance characteristics of the weakest link in the engine encapsulation (i.e. the baffle unit) and identify optimal design performance early in the design cycle (Fig. 3).

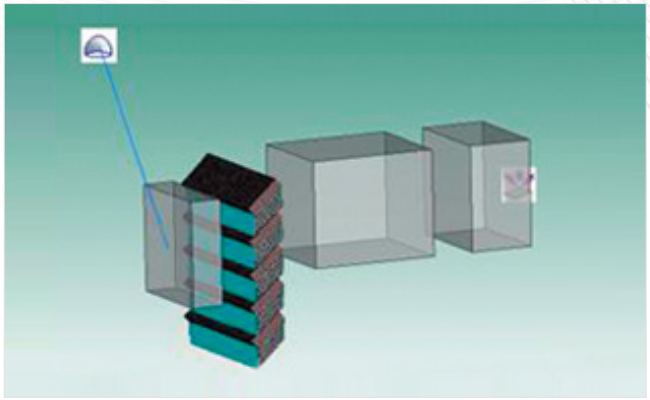

Fig.2: Hybrid SEA-FE-PEM model that represents setup in laboratory

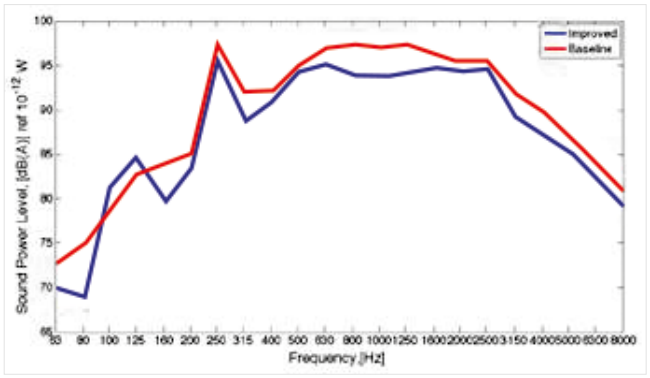

Fig.3: Comparison of emitted sound w/ improved front baffled panel

In summary, the use of ESI's VA One allowed Epiroc a more flexible approach than traditional engineering ever could. Complex systems were modeled based on existing measurements and databases, which allowed design engineers to identify cost effective solutions to meet performance targets. Furthermore, the study showed that work could be performed early in the design cycle along with other aspects of acoustic design without ever needing a physical prototype, based on the fact that the physical units are correctly understood. It is essential to model what is measured or validated in the end, even though it might sound simple.

To find out more about ESI's vibro-acoustic solution, visit: www.esi-group.com/software-services/virtual-performance/va-one

About Epiroc

Epiroc, previously part of the Atlas Copco Group, a 147-year old start-up, that is a leading global productivity partner for the mining and infrastructure industries. With ground-breaking technology, we develop and produce innovative, safe, and sustainable drill rigs, rock excavation and construction equipment, and tools. Epiroc also provides world-class service and solutions for automation and interoperability.

Rocktec, an engineering service division located in Orebro supports the other divisions within Epiroc by offering a variety of technical competences related to the differing engineering challenges encountered in the mining sector. One suchaspect of this support is Noise and Vibration.

About ESI GROUP

ESI is a pioneer and world-leading provider in Virtual Prototyping that takes into account the physics of materials.

ESI boasts a unique know-how in Virtual Product Engineering, based on an integrated suite of coherent, industry-oriented applications. Addressing manufacturing industries, Virtual Product Engineering aims to replace physical prototypes by realistically simulating a product's behavior during testing, to fine-tune fabrication and assembly processes in accordance with desired product performance, and to evaluate the impact of product use under normal or accidental conditions.

ESI's solutions fit into a single collaborative and open environment for End-to-End Virtual Prototyping. These solutions are delivered using the latest technologies, including immersive Virtual Reality, to bring products to life in 3D; helping customers make the right decisions throughout product development. The company employs about 1000 high-level specialists worldwide covering more than 40 countries. ESI Group is listed in compartment C of NYSE Euronext Paris.

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