

Innovative SCRonly concept by Liebherr for Diesel Engines of Tier 4 final: compact modules with high efficiency

March 2014 – Liebherr offers diesel engines to comply with Tier 4 final / stage IV without a diesel oxidation catalyst (DOC), while showing excellent operating values, reasonable costs for exhaust gas aftertreatment and extremely reduced complexity of the engines. Essential for this is the combination of modern combustion engineering, optimized DEF (diesel exhaust fluid) processing and the complete integration of relevant software functions in a new control unit.

New generation of diesel engines of Tier 4 final

The latest emissions legislation for off-road applications in Europe and the USA mean that there is no way around exhaust gas aftertreatment systems. Liebherr chose this challenge to develop engines with lower emissions while retaining a high performance. Besides fulfilling EU and US standards, Liebherr engines also satisfy various other local stipulations thanks to the modular structure of the exhaust gas aftertreatment systems.

The same basic engine for all emission standards

In order to comply with the emissions requirements, the Liebherr engine modules have been fully revised and restructured. With the Tier 4 final / EU stage IV, Liebherr offers a standardized basic engine that can be adapted to the emissions requirements in the different markets and regions by minor modifications or by fitting exhaust gas aftertreatment systems.

Specifically, that means that the engines in the emission standards Tier 2, Tier 3 and Tier 4 have the same performance, the same parameters for the cooling system and the same interfaces for installation. That enables customers to substantially simplify their machine design by allowing engines with different emission standards to be exchanged in the same machine. That is an important advantage for any equipment that is used all around the world.

Exhaust gas aftertreatment exclusively with SCR only

For exhaust gas aftertreatment, Liebherr employs exclusively SCR technology for Tier 4 final. For Tier 4 interim both particulate filters and SCR catalytic converters, depending on the application concerned, had been employed. Based on experience from the field with both systems, the requirements with respect to modularity, installation space, efficiency and service-friendliness Liebherr selected SCR technology for the Tier 4 final standards. At the same time, this system has been developed substantially further compared to the previous standard. The DEF additive is now injected into the exhaust gas together with air to ensure optimum atomization. The result is very high efficiency factors and an effective reduction of nitric oxides.

Ideal system integration and intelligent development solutions have made it possible to reduce untreated particulate emissions within the engine to a level below the specified limit. Liebherr engines no longer need a diesel oxidation catalyst (DOC), particulate filter (DPF) or exhaust gas recycling (EGR). That means that Liebherr is currently the only diesel engine manufacturer who satisfies the requirements of Tier 4 final without a diesel oxidation catalyst. With the "SCRonly" solution, no deterioration or destruction of the exhaust gas aftertreatment system is to be expected even if the machine is run on fuel with a higher sulphur content. This is particularly beneficial for equipment rental suppliers. Tier 4 final and stage IV equipment can also be used in countries where sulphur-free fuel is not always available.

For special requirements where even stricter emissions limits such as the Swiss emissions standard are applicable, machines for tunnel construction or for operation in enclosed halls, the Liebherr SCR system is supplemented by a particulate filter.

Common Rail system by Liebherr

In order to reduce particulate emissions within the engine, Liebherr has developed its own Common Rail fuel injection system. The system has a range of advantages over the systems available on the market from the supplier industry. These include, for example, the injection rate being optimally attained thanks to electronically controlled multiple injection and reduced power dissipation. The system is able to generate an injection pressure of 2,200 bar. However, in conjunction with the SCRonly system, this

pressure potential does not need to be used to the full. With the multiple injection concept, it is in particular the additional post-injection, which is responsible for the substantial reduction in particulate emissions.

Liebherr Engine Control Unit – all functions in one device

In order to attain excellent operating values, an optimal interaction between combustion-relevant parameters and exhaust gas aftertreatment is of great importance. The most important thing about exhaust gas aftertreatment is the right metering of the DEF additive, which depends on the current exhaust gas values.

Liebherr has developed its own engine control unit with integrated metering control and the necessary OBD functions so these interdependences can be regulated efficiently and safely. For On-Board Diagnosis systems, a number of sensors are fitted in the engine and in the exhaust gas aftertreatment, for example temperature and nitric oxide sensors both upstream and downstream of the SCR catalytic converter. Any remaining ammonium downstream of the catalytic converter is measured to regulate the efficiency of the AdBlue injection. The corresponding control unit has been developed to series production maturity in close collaboration between the Liebherr engine plant in Bulle, Switzerland, and the Liebherr Competence Centre for Electronics in Lindau, Germany.

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