DEVELOPMENT OF A CREEP RESISTANCE EXHAUST VALVE SUITE FOR MARINE DIESEL ENGINES CONTAINING CR-MO

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Exhaust valves of marine diesel engines are subjected to thermal yielding (working temperatures 380…400 °C) and mechanical yielding (running hours 8000…10000 hr). Both thermal and mechanical yielding are main sources for creep failure.

To enhance the capabilities of the exhaust valves to withstand the thermal and mechanical stresses, proper alloying elements should be added to the steel alloy. Furthermore, the valve design is of prime importance.

Both Cr and Mo are the main alloying elements in addition to Si, which is recently added to enhance the alloy capability. Chromium (Cr)-Molybdenum (Mo) steel alloys are usually used for high temperature applications, where Mo delays the creep rate and suppress the coagulation and coarsening of carbides under hot temperature conditions. On the other hand, Cr is added to the alloy to enhance oxidation resistance of steel. At the same time Cr creates good hardening ability and provides excellent working strength to the steel. The alloy designers add Si to secure a ferrite portion in the steel matrix to provide the alloy with some ductility for reducing brittle failure.

The project is dealing with alloy design and specs of the exhaust valve for marine diesel engines, which would lead to improvement of failure resistance at about 10000 hr running hours and an ambient temperature 400 °C.

The project contains multi-phases and steps starting with alloy preparation of 0,4 % C steel. The alloy additionally contains 10 % Cr, 2…3 % Si and 1…1,4 % Mo. The forging die for the primary valve shape would be designed and machined putting into consideration tolerances of shaping and machining. The alloy would be subjected to control hot forging by using the forging dies. Forged parts are then finally heat treated.

Laboratory and field testing would be executed on the alloy as well as on the designed valve.