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A Study on the Causes of Diesel Injector Claims in India through Low-Pressure Fuel System Analysis

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The diesel injector claim rate in the Indian market is relatively high, with approximately 93% occurring within the three-year warranty period. Main symptoms include poor starting performance, noise, and reduced power output, with significantly higher incidence rates in northern regions. The injector re-repair rate of 10.5% suggests that external factors rather than inherent injector defects are the primary cause. Approximately 60% of failed injectors were caused by foreign substances and rust, and contaminants larger than the 4 ㎛ filter mesh size were detected, necessitating investigation of fuel filter internal leakage phenomena.

At low temperatures, paraffin wax crystallizes in diesel fuel, degrading flowability. The cloud point (CP) is the temperature at which wax precipitates causing turbidity, the cold filter plugging point (CFPP) is when 20 mL of sample takes over 60 seconds to pass through a 45 ㎛ filter, and the pour point (PP) is when fuel ceases to flow. Europe, Korea, and India operate different low-temperature fuel management standards, with India's winter requirements being relatively relaxed.

Low-temperature chamber tests revealed that filter type B exhibited internal leakage at the cartridge welding joint under PP conditions, while filter type A with reinforcement structures showed no leakage. CT scans and physical dissection confirmed that leakage originated from the welding area rather than O-rings.

Field tests in northern India recorded 2022 minimum temperatures of -10°C at KARGIL and -16°C at LEH, both below CFPP and PP limits. Considering the 4°C temperature difference between ambient and fuel during overnight soaking, predicted fuel temperatures of -6°C for KARGIL and -12°C for LEH align with chamber test conditions, indicating potential filter leakage risk.

Diesel filter internal leakage results from pressure differentials caused by paraffin wax crystallization. Structural design improvements and heater integration are effective countermeasures. Notably, application of cartridge deformation-preventing structures alone significantly mitigates leakage risk without heater implementation.

In conclusion, pressure differentials across filters caused by paraffin wax crystallization induce internal leakage in specific filter designs. Structural improvements and heater application are effective solutions, while deformation-prevention structures alone can substantially reduce leakage risk.

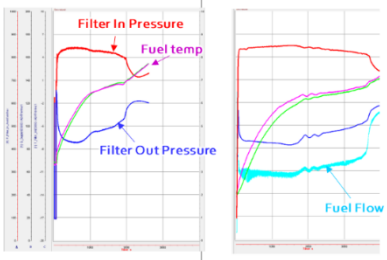
	A Vehicle No leakage up to 2 cycles at -15℃	
Soaking Temp	-11℃	-15℃
Test Graph		
Filter Differential Pressure	Max 413kPa	Max 434kPa
Results	Differential pressure generated → No internal filter leakage	
Filter Supplier	A	

Fig.1 Low-Temperature Chamber Test Results with A Filter

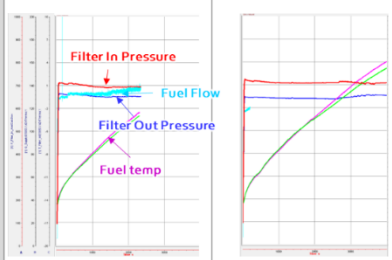
	B Vehicle Leakage occurred on 1st cycle	C Vehicle Leakage occurred on 2nd cycle
Soaking Temp	-11℃	-15℃
Test Graph		
Filter Differential Pressure	Max 47kPa	Max 74kPa
Results	No differential pressure generated → Internal filter leakage occurred	
Filter Supplier	B	

Fig.2 Low-Temperature Chamber Test Results with B Filter