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LPG ENGINE EXHAUST GAS EMISSION TESTS - (CARBON MONOXIDE)

1. SUBJECT

The evaluation and tests, of a petrol engine running on LPG (Liquid Petroleum Gas), exhaust gas emission to determine the efficiency of an exhaust gas Purifier.

2. DESCRIPTION

The engine evaluated and tested was fitted to a Toyota forklift. The Purifier was integrated into its exhaust system to form one complete system that clean the exhaust gases to an acceptable/safe level in a work environment. The exhaust system consisted of the following components:

- 2.1 **Engine:** Toyota 4Y-ECS LPG (naturally aspirated) (11161 hours), displacement: 2,4l, engine serial No: 34365, fitted to a forklift, model No: 32-8FG25.
- 2.2 **Exhaust pipe:** All standard 38mm dia. mild steel tube.
- 2.3 **Purifier (Catalytic Converter):** John Ratcliffe, Model: HEP6 LPG
- 2.4 **Silencer:** Standard Toyota forklift component.

3. ENGINE EXHAUST SYSTEM

- 3.1 **Composition:** The exhaust system was integrated as one assembly in the following consecutive order: Engine - Exhaust pipe - Purifier - Exhaust pipe - Silencer - Outlet pipe.
- 3.2 **Sample reading points:** Carbon Monoxide (CO) extraction and temperature reading points:
 - a. Point "A" before Purifier - Between manifold and Purifier.
 - b. Point "B" after Purifier and Silencer - Exhaust pipe outlet.

4. TEST METHODS AND RESULTS

All tests were conducted while operating the engine under low idle speed conditions and the temperature has stabilized.

4.1 Test instruments:

- a. Carbon Monoxide (CO): Dräger tubes - CH 20601
- b. Temperature: Major-Tech (Ser.No: SM030)

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4.2 TEST SET-UP

The Purifier was fitted into the standard exhaust system of the Toyota forklift by mean of a mild steel exhaust pipe. For each test an extraction tube was inserted into the relevant test points "A" or "B" for measuring Carbon Monoxide (CO). For temperature readings a thermocouple was inserted into the test points and the readings taken direct after the gas tests were conducted.

4.2.1 Carbon Monoxide (CO) and temperature readings: These readings were taken to verify the CO readings before and after the Purifier at a known temperature and engine speeds:

4.2.2 Low Idle Engine Speed:

4.2.2.1 Test 1 (CO): Before Purifier - The engine was running at low idle speed. The test pipe was inserted into test point "A" and attached to the Dräger pump, via the Dräger test tube. One stroke was executed after which the reading was recorded.

Results: 1000+ ppm **Temperature:** 450°C

4.2.2.2 Test 2 (CO): After Purifier - The engine was running at low idle speed. The test pipe was inserted into test point "B" and attached to the Dräger pump, via the Dräger test tube. One stroke was executed after which the reading was recorded.

Results: 50 ppm **Temperature:** 450°C

4.2.3 High Idle Engine Speed:

4.2.3.1 Test 1 (CO): Before Purifier - The engine was running at high idle speed. The test pipe was inserted into test point "A" and attached to the Dräger pump, via the Dräger test tube. One stroke was executed after which the reading was recorded.

Results: 1000+ ppm **Temperature:** 657°C

4.2.3.2 Test 2 (CO): After Purifier - The engine was running at high idle speed. The test pipe was inserted into test point "B" and attached to the Dräger pump, via the Dräger test tube. One stroke was executed after which the reading was recorded.

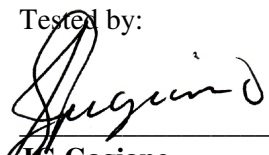
Results: 10 ppm **Temperature:** 657°C

5. TEST RESULTS SUMMARY: The efficiency of the Purifier is illustrated in Table 1.

TABLE - 1

IDLE SPEED	EMISSION TEMP °C	BEFORE	AFTER	REDUCTION	%
Low	CO Temp. °C	(A) 1000+ ppm 450°C	(B) 50 ppm 450°C	950 ppm	95 %
High	CO Temp. °C	(A) 1000+ ppm 657°C	(B) 10 ppm 657°C	990 ppm	99 %

Tested by:



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