Bulletin of the *Transilvania* University of Braşov • Vol. 2(51) – 2009
Series I: Engineering Sciences

A FEW CONSIDERATIONS REGARDING THE MAN K8SZ 70/150 CLe NAVAL DIESEL ENGINE RUNNING

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Abstract: *In this paper are presented some results of experimental determinations aimed at ensuring of a high uniformity in the naval propulsion engines running. The results were obtained in real operating conditions on board "Histria Diamond" and made part of a wider program of research aimed to establish which particular use of heavy residual fuel in marine diesel engine operation.*

Key words: *engine, diesel, naval, propulsion, running.*

1. Introduction

In particular purpose of highlight the engines naval operation with heavy fuel have been performed a series of measurements of functional parameters of some naval propulsion engines at various operating regimes. In this paper we presents some of the purchases carried on board "Histria Diamond" during 10.04-08.07.2005; the vessel is equipped with a main engine named MAN K8SZ 70/150 CLe.

2. Experimental results

During a long voyage, was forced to carry out some maintenance works including adjusting of injection advance angle and the cleaning of exhaust gas area of exhaust-gas boiler. After this work were measured functional parameters of the propulsion engine, achieving the results in Figure 1, centralized in Table 1. Figures 2 and 3 are illustrated graphically the assignment of the functional parameters between the engine cylinders.

As was expected, after the decreasing of the injection advance angles, the exhaust gas temperatures for each engine cylinder increased. But imposed a reduction of about one degree angle of injection advance to the cylinder No. 8. Table 2 are centralized the results after this adjustment.

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Imes Cyliunder Pressure Measuring System EPM-XS, Engine Report																					
Ship/Power station: M/T „Histria Diamond”							**Engine type: MAN K8SZ 70/150 Cle**							**Data read: 20.06.2005**							
Engine Power: 9284 HP					**Power A side: N/A**							**Power B side: N/A**					**Power diff. A/B: N/A**				
General info		**Load: no**				**Loaded: no**				**Ballast: 22000 Mts**				**OBS Speed: 12 Knts**				**Wind: m/s-Knts: E4 Beauf**			
		Sea temp.: 24 Cdgr.				**Eng. temp.: 45 Cdgr.**				**Sea: 3**				**Barom. Press.: 1013 mbar**							
Fuel Info		**Temp. 120 Cdgr.**				**Viscosity 19 cSt**				**Fuel quality: IFO 380@50C**				**Governor index: 65**							
Consumption		**Fuel consumption: 32000 kg/24h**										**Cylinder oil cons.: 1.9 gr/HP·h (450 kgs/24hrs)**									
Running hours		**Running hour total: 72140**										**Running hours since last report: 12 Hrs**									
T / C1		**RPM 10900**				**Scav.air press.: 0.92 bar**				**Scav.air temp.: 56 Cdgr.**				**Ex.temp.before: 490 Cdgr.**				**Ex.temp.after: 390 Cdgr.**			
		Press.drop cooler: 30mmWC				**Cool temp.in: 26 Cdgr.**				**Cool temp.out: 30 Cdgr.**				**Luboil temp.: 72 Cdgr.**				**H:s overhaut 12520**			
T / C2		**RPM 11000**				**Scav.air press.: 0.92 bar**				**Scav.air temp.: 60 Cdgr.**				**Ex.temp.before:**				**Ex.temp.after: 390 Cdgr.**			
		Press.drop cooler: 170mmWC				**Cool temp.in: 26 Cdgr.**				**Cool temp.out: 36 Cdgr.**				**Luboil temp.: 72 Cdgr.**				**H:s overhaut 12520**			
Cylinder		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Pmaxmean	bar	92	93	89	91	89	90	91	86												
Pmaxmax	bar	96	97	94	95	92	93	94	90												
Pmaxmin	bar	91	92	86	89	86	87	85	83												
MIP	bar	13.54	12.86	12.89	13.53	12.57	12.93	12.59	12.79												
Alpha Pmax	bar	10	10	9	10	9	10	11	11												
Pcomp	bar	55	55	50	49	49	52	54	49												
Pinj	bar																				
Pinj open	bar																				
Pexh open	bar																				
Pexh close	bar																				
Max.change	bar	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7												
PMI Diff.	bar	-0.02	-0.71	0.67	-0.03	-0.99	-0.63	0.97	4.03												
Pump index	%	76	78	72	74	73	77	74	75												
Pmax diff.	%	1	0	4	2	4	3	2	3												
RPM	rpm	96	95	95	95	95	96	95	95												
Cycles	Cycles	10	10	10	10	10	10	10	10												
Power	HP	1250	1174	1178	1236	1148	1194	1150	1167												
Exhaust	°C	370	370	400	380	372	392	382	380												
Cool.water out	°C	74.3	73.8	74.3	74.4	74.5	74.4	73.8	75.1												
Piston cool.out	°C	58	58	58.8	57.9	58.9	57.7	57.6	57.1												
Exhaust valve	h	10.4	10.0	10.6	10.2	10.6	10.0	9.2	11.0												
Liners	H	1194	2156	1120	1154	2156	2165	2156	1687												
Info	*Delta T cyt . T/C cooling outlet: 98/89 Cdgr. Exhaust gas pres. before/after turbine: Fore: 0.7 bar / 40 mmwc; aft: 0.65 bar / 0.65 mmwc*																				

Fig.1. *Sheet of functional parameters of the MAN K8SZ 70/150 CLe engine, determined with the IMES electronic device on 20.06.2005*

Results of initial measurements made on 20.06.2005 Table 1

Parameter	Value	Parameter		Value
Engine speed [rpm]	95	Sea water temperature [°C]		24
Turbocharger speed [rpm]	11000/ 10900	Atmospheric pressure [mbar]		1013
Turbocharging air pressure [bar]	0,92	Weather & sea conditions		grd. 2 la 3 şi wind 4 from Pv/Bb
Turbocharging air temperature [°C]	60	Medium fuel pump index		75,10
Pressure drop of turbocharging air in coolers [mmH_2O]	170	Load index		65
Engine room temperature [°C]	45	Cylinder cooling water temperature [°C]	Inlet	71
Fuel temperature at injection [°C]	120		Outlet	75

	Cylinder No.							
	1	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Fuel pump index [mm]	76	78	72	74	73	77	74	75
Exhaust gas temperature [°C]	370	370	400	380	372	392	382	380
Maximum combustion pressure [bar]	92	93	89	91	89	90	91	86
Injection advance angles [°RAC]	10,4	10,0	10,6	10,2	10,6	10,0	9,2	11,0

Results of final measurements made on 20.06.2005 Table 2

Parameter	Value	Parameter		Value
Engine speed [rpm]	95	Sea water temperature [°C]		24
Turbocharger speed [rpm]	11000/ 10900	Atmospheric pressure [mbar]		1013
Turbocharging air pressure [bar]	0,92	Weather & sea conditions		grd. 2 la 3 şi wind 3 from Pv/Bb
Turbocharging air temperature [°C]	58	Medium fuel pump index		75,25
Pressure drop of turbocharging air in coolers [mmH_2O]	171	Load index		65
Engine room temperature [°C]	44	Cylinder cooling water temperature [°C]	Inlet	70
Fuel temperature at injection [°C]	119		Outlet	74,5

	Cylinder No.							
	1	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Fuel pump index [mm]	76	77	74	74	73	77	76	75
Exhaust gas temperature [°C]	373	380	390	385	379	396	374	376
Maximum combustion pressure [bar]	92	92	90	91	89	90	91	89
Injection advance angles [°RAC]	10,4	10,0	10,6	10,2	10,6	10,0	9,2	10,0

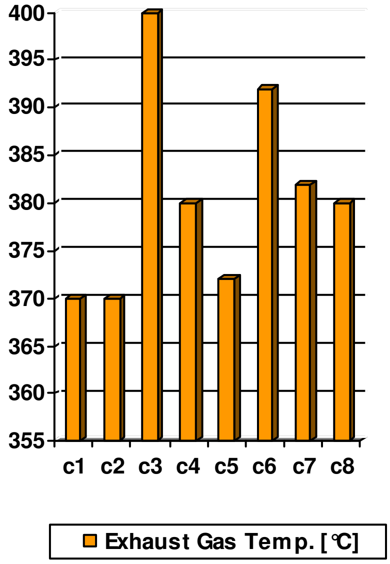

Fig.1. *The values of exhaust gas temperature on 20.06.2005 (the initial determination)*

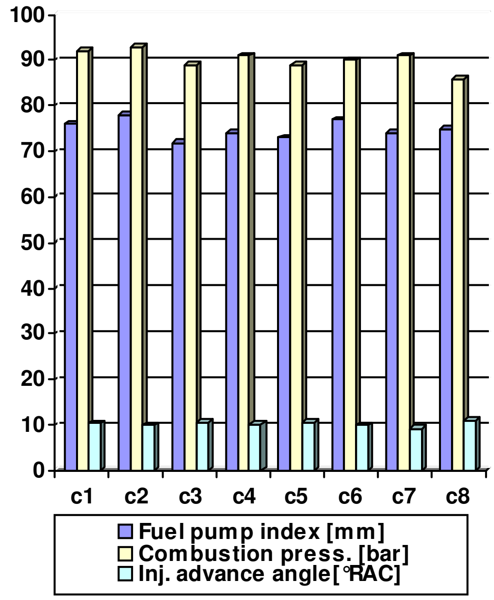

Fig.2. *The values of functional parameters of the engine on 20.06.2009 (the initial determination)*

The percentage deviations of the exhaust gas temperatures Table 3

Parameter		**Mean value**	**Cylinder No.**							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Percentage deviations of the exhaust gas tempertures Δt_{ev} [%]	Initial determi-nation	380,750 °C	–2,823	–2,823	+5,056	–0,197	–2,298	+2,955	+0,328	–0,197
	Final determi-nation	381,625 °C	–2,260	–0,426	+2,195	+0,884	–0,688	+3,767	–1,998	–1,474
Percentage deviations of the maximum combustion pressures Δp_{max} [%]	Initial determi-nation	90,125 bar	+2,080	+3,190	–1,248	+0,971	–1,248	–0,139	+0,971	–4,577
	Final determi-nation	90,50 bar	+1,657	+1,657	–0,552	+0,552	–1,657	–0,552	+0,552	–1,657

After the results examination, can be noticed a considerable increase in engine operation uniformity. This is illustrated in Table 3 and Figures 3 and 4, which reflects the considerable decrease of the percentage deviations of the exhaust gas temperatures and the maximum combustion pressures.

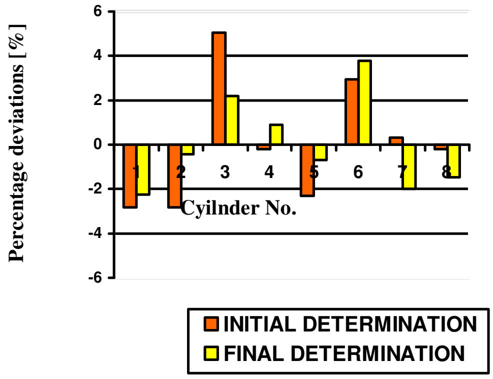

Fig.3. *The dispersion of percentage deviations from the exhaust gas temperatures*

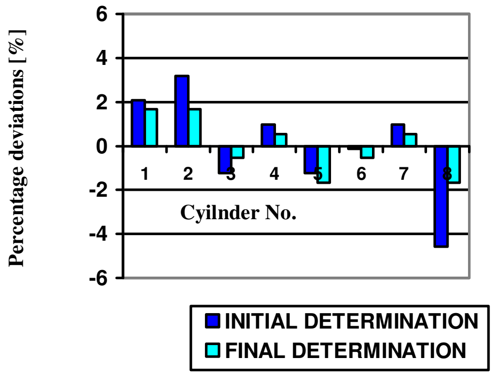

Fig.4. *The dispersion of percentage deviations from the maximum combustion pressures*

3. Conclusions

As mentioned initially, one of the sets of determinations was imposed by the emergence of doubts on the bad uniformity of engine operation (different allocation of the loadings on the engine cylinders), as well as regarding the proper functioning of some of the individual injection pumps.

The obtained results confirmed the necessity and the opportunity of the maintenance works. Given the technical conditions of the engine, it was decided that further adjustments to be made only after the cleaning operations of the lines 2, 5, 6 and 7.

The results presented are part of a broader research program, conducted in the period 2005-2008, in order to determine some solutions to increase the efficiency of diesel naval engines operation with heavy residual fuels.

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