

Bunker Management

*Fully transparent ROB via tank gauging system,
applied statistics and long term evaluation*

By Hauke Hendricks

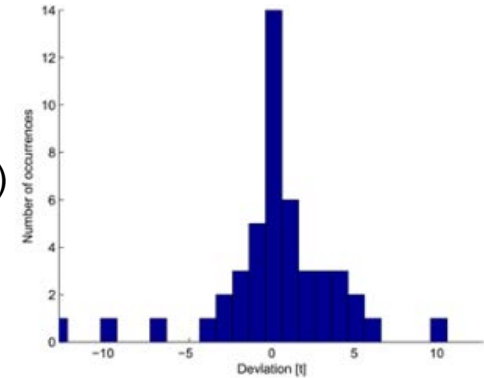


Methods of Measuring (1)

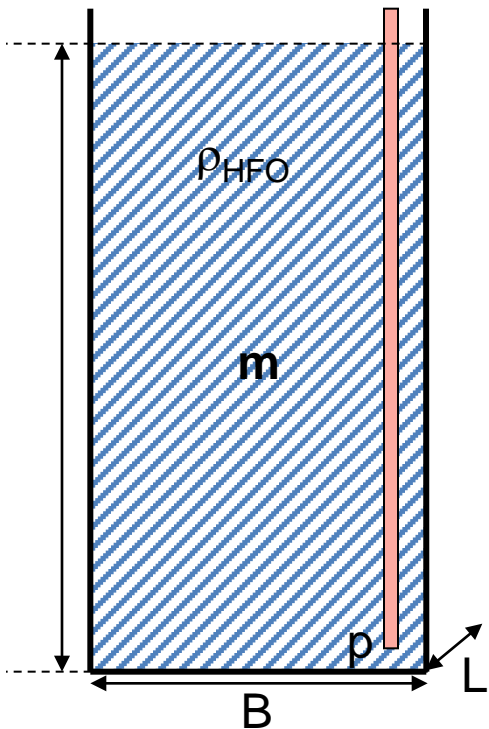
- Implement reference for proper measurement
 - Settling Tank as “measuring cup”
 - Measuring deviation in fuel transfer (Settling – in / Storage – out)
 - Redundant analysis (sum of each transfer vs beginning/end of period)
 - Sensor failure: redundant measuring

- Error analysis of every single transfer

- Hydrostatic Pressure Type System
 - Eliminate “Cappuccino” effect



Methods of Measuring (2)



$$p = \rho_{HFO} \cdot g \cdot h \quad \Rightarrow \quad h = \frac{p}{g \cdot \rho_{HFO}}$$

$$m = V \cdot \rho_{HFO}$$

$$V = A \cdot h$$

cubic tanks
only

$$m = \frac{A \cdot p}{g \cdot \rho_{HFO}} \cdot \rho_{HFO} = \frac{A \cdot p}{g}$$

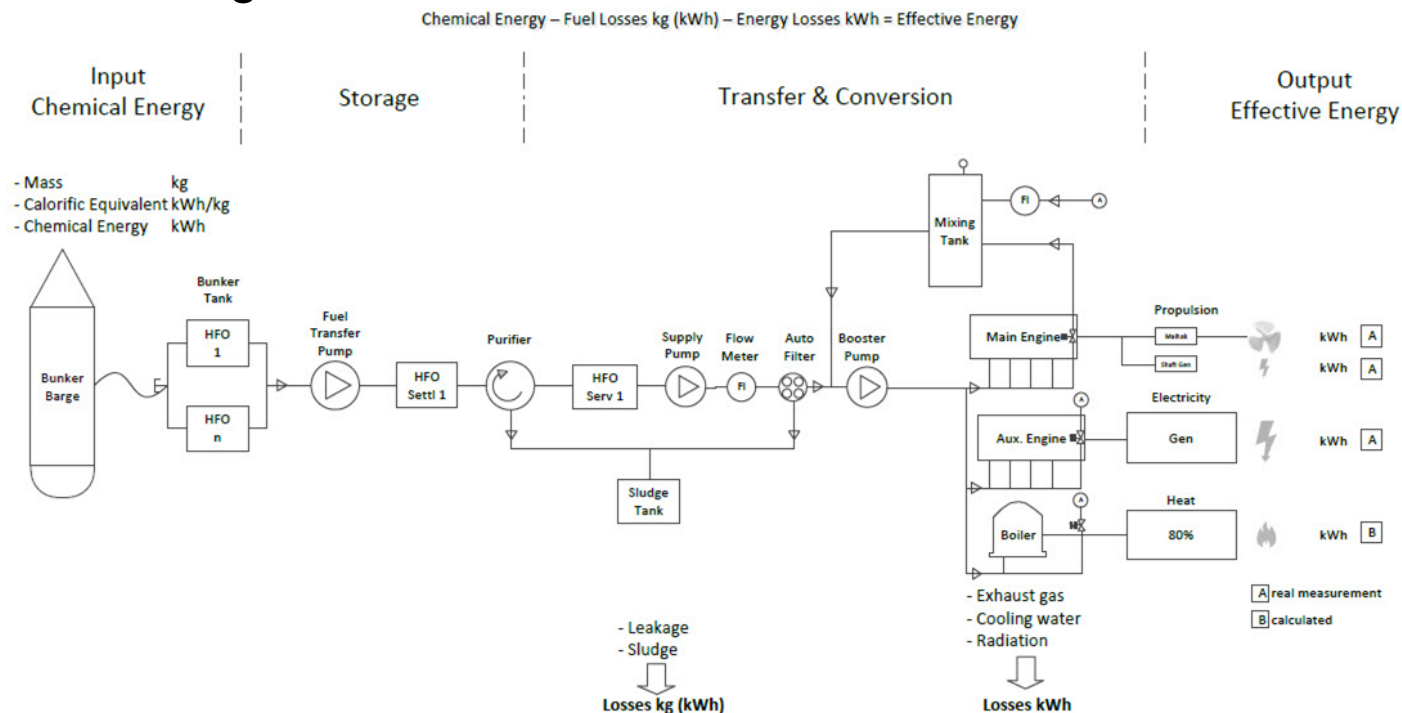
calculated mass is independent
from fuel oil density !!!

m =
 ρ_{HFO} =
 A =
 g =

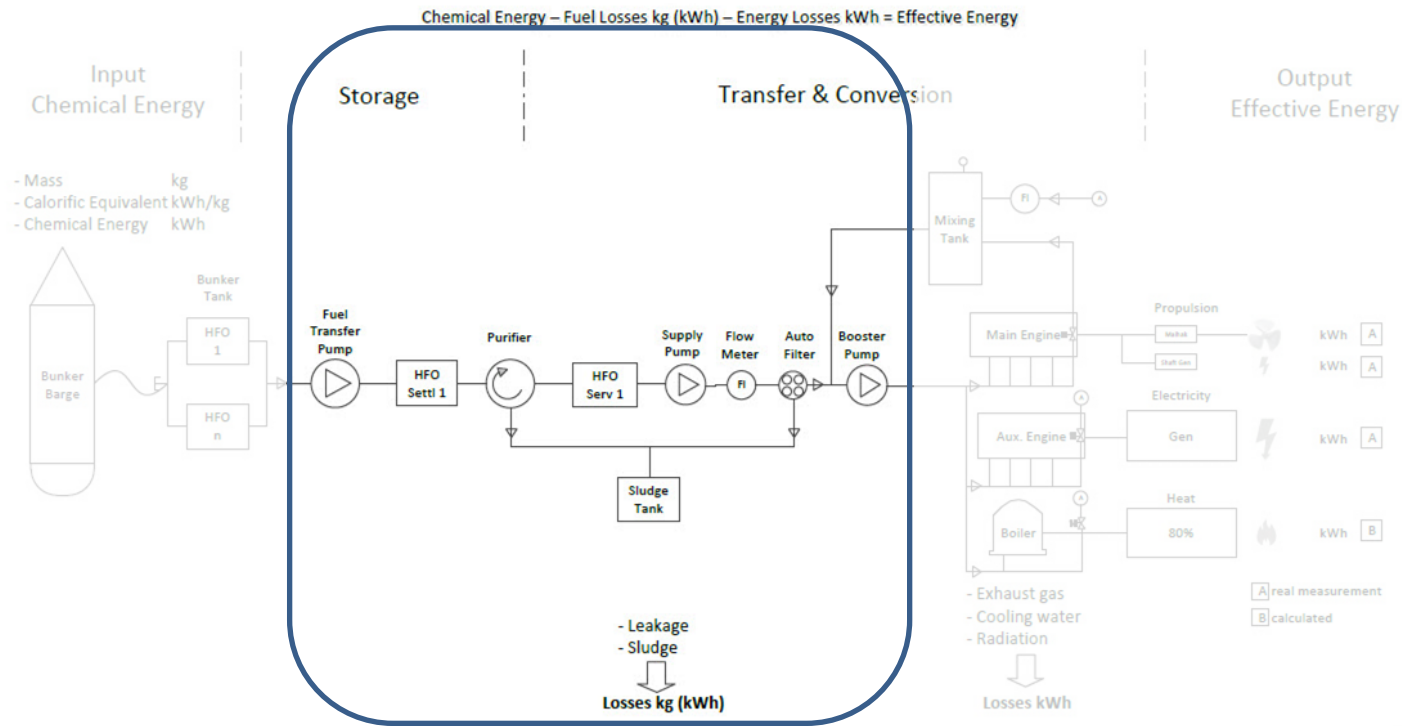
calculated mass of HFO
density of fuel oil
area cross section of tank
gravitational constant (9.81m/s²)

p = measured pressure
 V = fueled tank volume
 h = fill height

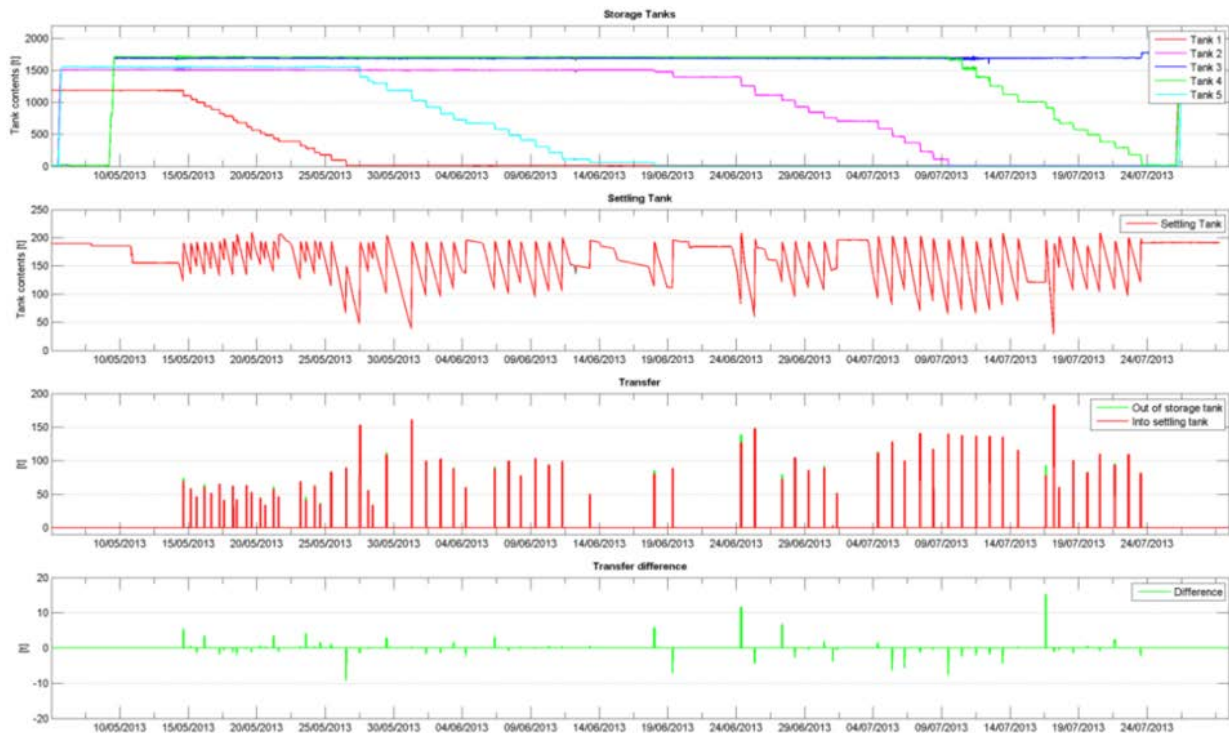
Energy Processing



Bunker Transfer



Bunker Transfer



Tank Transfer Diagnostic: 05-May-2013 08:00:00 to 29-Jul-2013 23:57:00; 21-Oct-2013 16:28:58

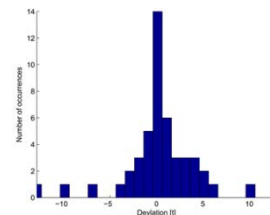
Comparison output and input
transfer sequence

Storage out transfer sum: 5.688 t

Settling in transfer sum: 5.694 t

Error analysis of
individuall transfers

Mean precision
of ~ 0,2 %



Fuel Transfer Report

General Information

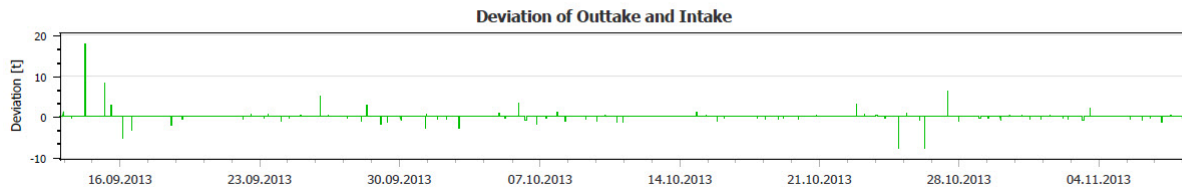
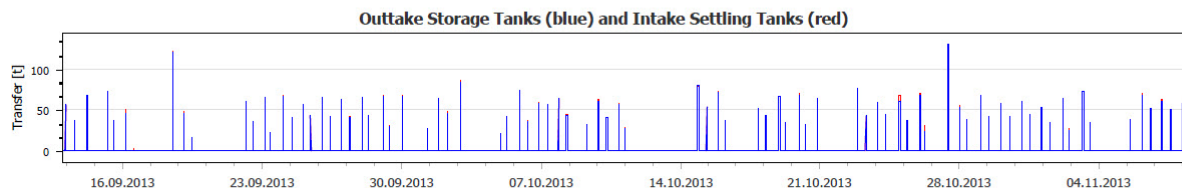
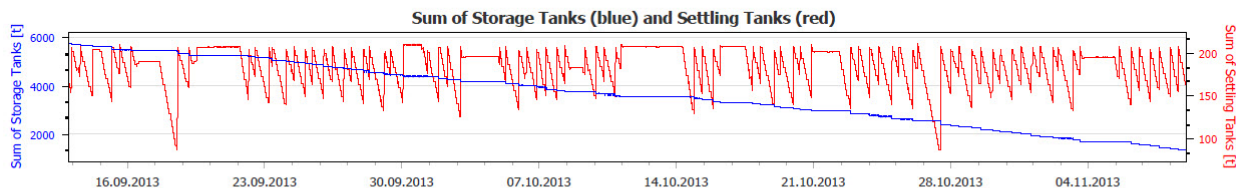
Vessel name Hamburg Express
IMO 9461051
Report Begin (UTC) 13.09.2013 00:00:00
Report End (UTC) 09.11.2013 00:00:00
Duration 57,0 d
Fuel type HFO

Total FOC

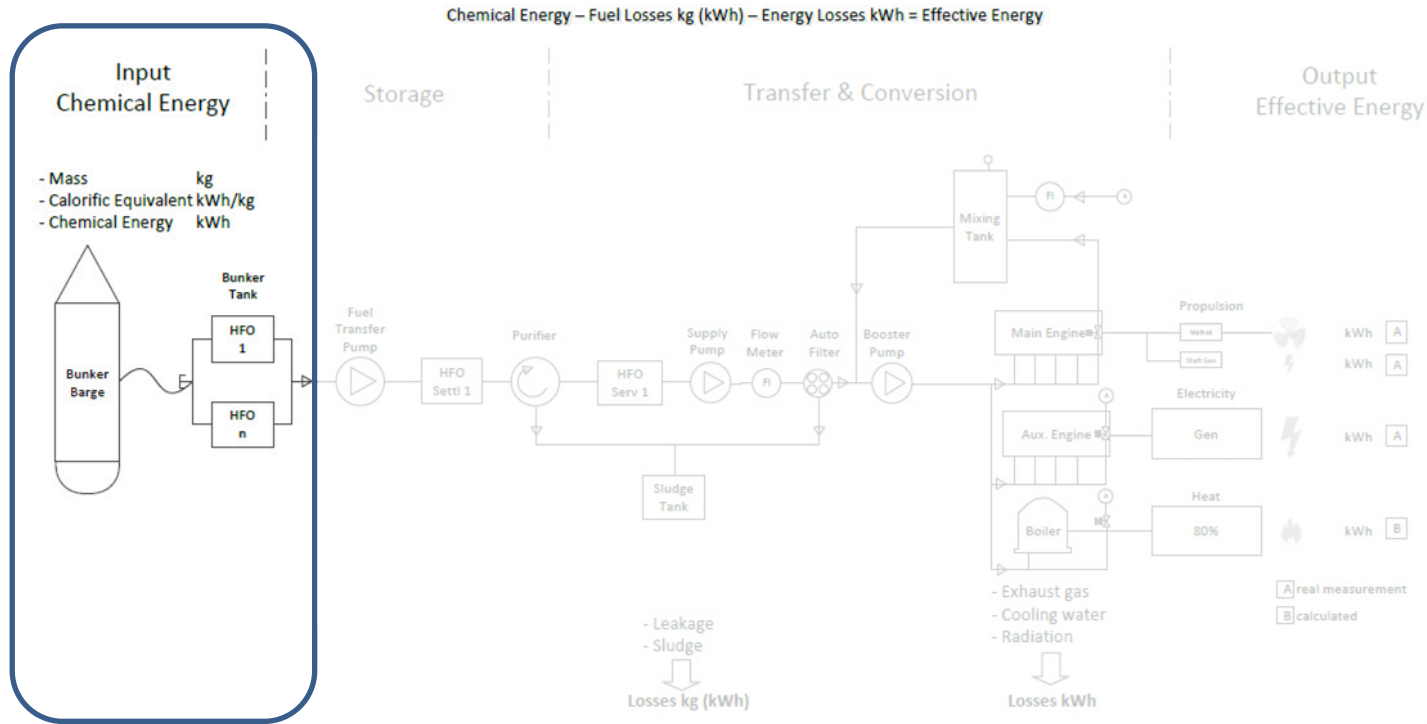
Settling Intake 4433,9 t
Settling Outtake 4438,0 t
Fraction of invalid data 0,0 %
Storage Content Begin 5767,7 t
Storage Content End 1322,4 t
Storage Difference -4445,2 t

Transfer Comparison Summary

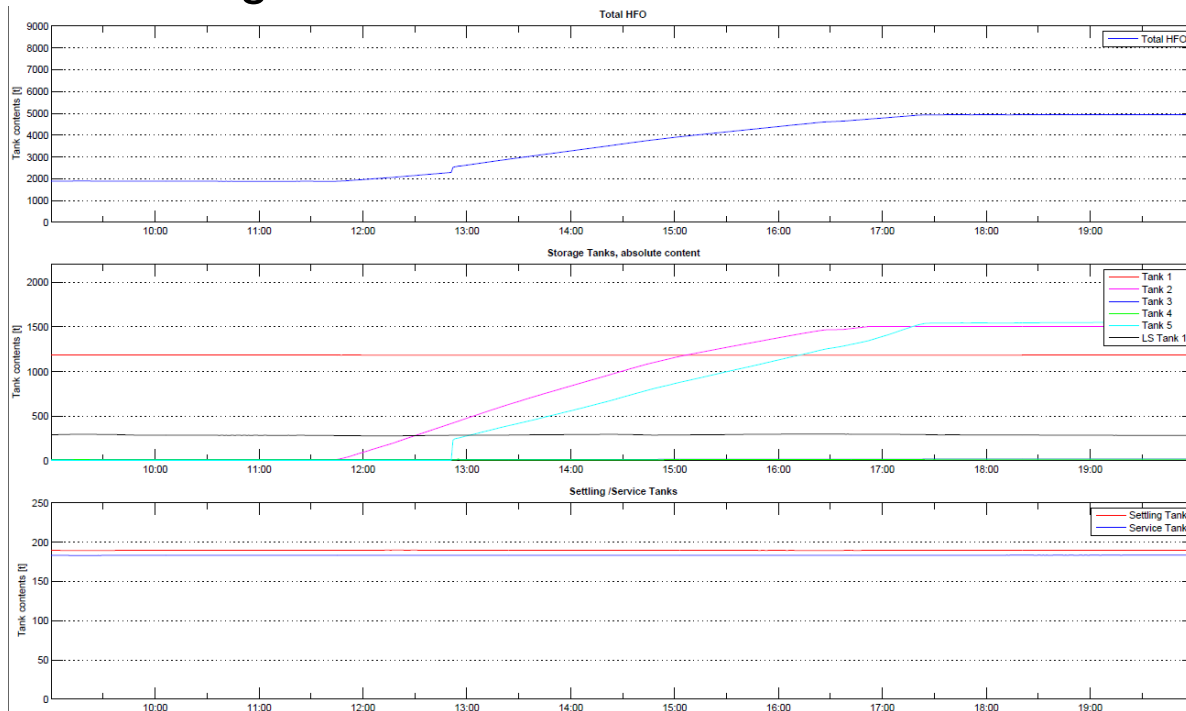
Number of detected Pump Events 86
Number of considered Pump Events 86
Considered Storage Outtake 4435,7 t
Considered Settling Intake 4433,9 t
Total Deviation 1,8 t 0,0 %
Mean Deviation per Transfer 0,0 t 2,9 t



Bunkering



Bunkering



HFO Trend: 05-May-2013 09:00:00 to 05-May-2013 20:00:00; 22-Oct-2013 12:14:51

Bunker Tank Content Summary

	Content	Intake	Content
HFO 1	1.184 t	0 t	1.184 t
HFO 2	13 t	1.493 t	1.506 t
HFO 3	14 t	0 t	14 t
HFO 4	11 t	0 t	11 t
HFO 5	3 t	1.549 t	1.552 t
LS HFO 1	283 t	0 t	283 t

Summary 1.508 t 3.042 t 4.550 t

First Bunkering

Tank 2	13 t	1.493 t	1.506 t
Tank 5	3 t	1.549 t	1.552 t

Tank Content

Settling Tank	190 t
Service Tank	183 t

Bunker Discrepancy Report

General Information

Bunker Begin (UTC)	13.11.2013 13:00:00	Vessel name	Hamburg Express
Bunker End (UTC)	13.11.2013 22:24:31	Callsign	
Latitude		IMO	9461051
Longitude			
Port			

Supplier Information

Supplier	
Representative	
Order No	
Delivery Note No	
Expected Quantity	4500,00 t

Bunker Quality Information

Specification	
Density	
Sulphur Content	
LHV	
Price	

Bunker Quantity

Tank	Content Begin	Content End	Intake
No1 HFO PS t	31,5 t	1029,8 t	998,3 t
No1 HFO SB t	36,9 t	1094,8 t	1057,8 t
No2 HFO PS t	33,9 t	1229,1 t	1195,2 t
No2 HFO SB t	31,8 t	1232,3 t	1200,4 t
No3 HFO SB t	704,4 t	706,8 t	2,4 t
FWD FO OVER t	2,5 t	2,8 t	0,3 t
	841,1 t	5295,6 t	4454,5 t
		Expected quantity	4500,0 t
		Discrepancy	-45,5 t
			-1,01 %