

CRT: 1,200 Berlin buses retrofitted since 2000

Burkhard Eberwein

Public Service Bus Department

Berliner Verkehrsbetriebe (BVG)

Public Law Company



Overview of Berliner Verkehrsbetriebe (BVG)

BVG

12,224 total staff
 8,712 blue-collar workers
 3,512 white-collar workers
 (incl. 405 trainees / apprentices)



1,035.2 million passenger trips / year

Underground

- 144.9/120.3 km total route length (day/night)
- 9 day-time lines
- 7 night lines
- 3/2 workshops / main workshops
 - 1 workshop for underground vehicles
- 170/145 stations (day/night)
- 1,372 underground vehicles
- 2,791 staff
- 456.8 million passenger trips / year

Tram

- 285.5/59.7 km total route length (day/night)
- 21 day-time lines
- 5 night lines
- 6 depots
- 374/115 stops (day/night)
- 602 vehicles
- 1,634 staff
- 171.3 million passenger trips / year

Bus

- 1,626/751 km total route length (day/night)
- 150 day-time lines
- 54 night lines
- 6 depots
- 2,601/1,504 stops (day/night)
- 1,388 buses
- 3,931 staff
- 407.1 million passenger trips / year

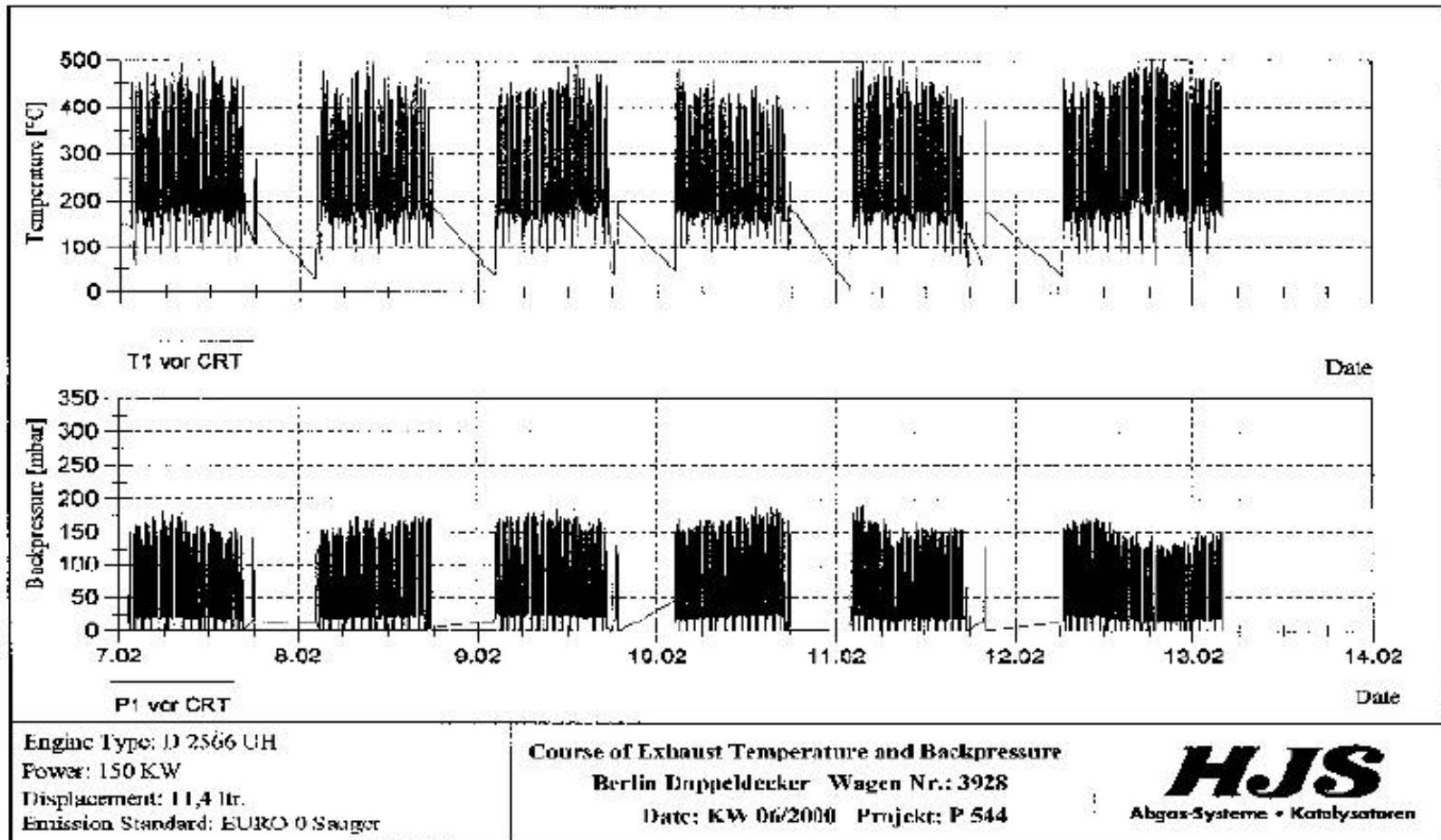
Environmental measures so far tested in BVG's buses

<i>Technology</i>	<i>Vehicle</i>	<i>Additional costs compared to diesel</i>
Methanol (1985 - 1988)	7 MAN SL 200 7 Mercedes Benz O305	approx. 28%
CNG (1996 - 1999)	4 MAN NG 232 2 Mercedes Benz O405 GN 4 Mercedes Benz O405 N	approx. 20%
Aquazole* (1999)	15 buses	approx. 8% / 100km additional consumption
CRT (1999 - 2001)	800 buses retrofitted and all new buses	approx. 5500 EUR/unit
Euro 5 / EEV (2003 – to date)	25 VOLVO buses	Funded by the German Ministry of Environment
Euro 5 / EEV	new buses to be commissioned in 2006	series
Hydrogen (2006 – to date)	4 MAN suction engine (in operation) 1 ICE / FC hybrid (in operation) 10 MAN ICE turbo charged (planned)	

* Diesel water blend helping to reduce NOx emissions

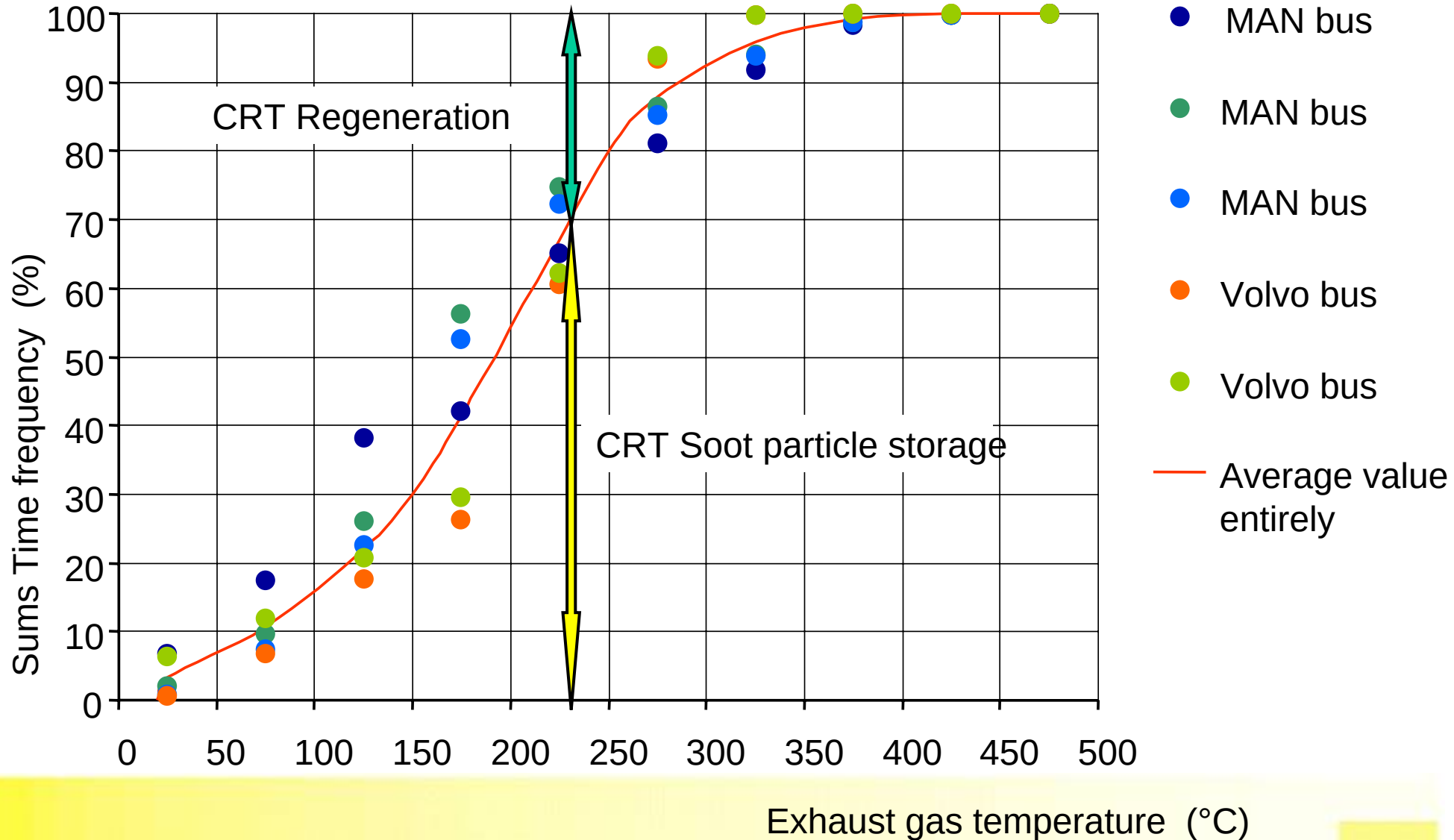
Temperature and exhaust-gas back-pressure ahead of CRT

(Berlin double-decker, February 2000)

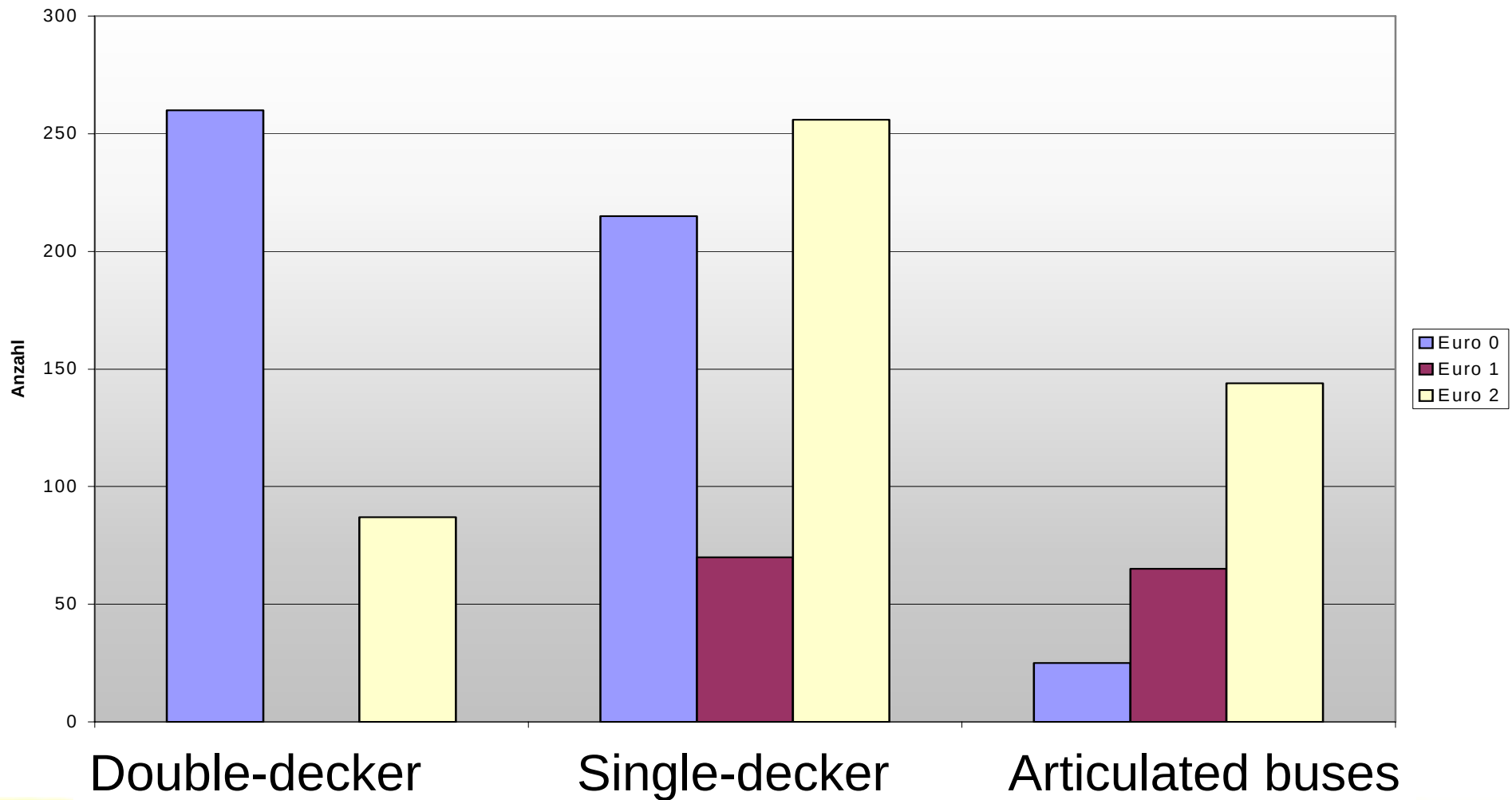


Cumulative probability of bus exhaust-gas temperatures

(CRT filter regenerates above curve, but accumulates particles below curve)



BVG bus fleet composition (number of buses) in 1998

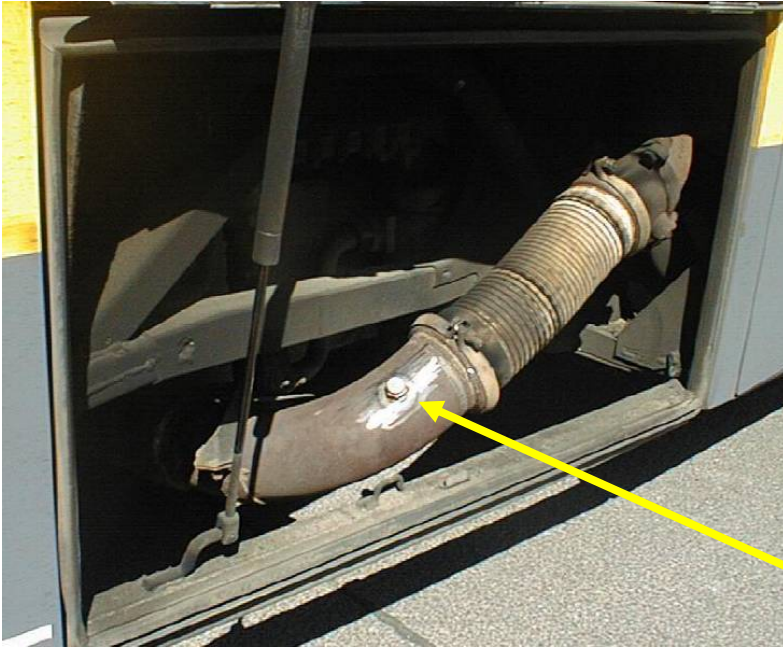


CRT Filter mounting

By the end of 1999, BVG had retrofitted (Fig. 4) 126 city buses. By the end of 2002, 1,000 of its total 1,350 buses were retrofitted with this system. All new vehicles purchased after 1999 came with the CRT ex-factory.



Back-pressure instrument and location



- Exhaust-gas back-pressure measurement
- Vehicle warmed up (75°C)
- Connect instrument
- Run engine at limiting RPM for 1 minute
- Read exhaust-gas back-pressure
- If the back-pressure exceeds prescribed level, then filter cleaning is necessary



Exhaust-gas back-pressure alarm display in new buses



Quality assurance software

(Screen shot of bus data, e.g. type, filter, date, odometer, test history, etc.)

Microsoft Excel - Fahrzeuge.xls

Datei Bearbeiten Ansicht Einfügen Format Extras Daten Fenster ?

Arial 12

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	lfd. Nr.:	Fahrzeug		Filter	Messungen eingeben	1. Prüfung	Blatt exportieren	2. Prüfung						
2		Nummer	Typ	Typ	Einbau-datum	Nummer	Datum	Kilometer	LL-Wert in Millibar	VL-Wert in Millibar	Datum	Kilometer	LL-Wert in Millibar	VL-W in Milli
85	83	1271	E13	60M	22.09.03	603290/703528	02.01.05	177.495	5	20	27.04.05	194.260	5	37
86	84	1272	E13	60M	23.09.03	603281/703530	17.01.05	174.977	5	43	19.04.05	194.718	12	42
87	85	1273	E13	60M	23.09.03	603285/703225	27.04.05	192.162	5	51				
88	86	1274	E13							94	18.04.05	194.975	4	42
89	87	1275	E13							33	28.04.05	184.819	5	42
90	88	1276	E13							53	09.02.05	180.312	6	50
91	89	1277	E13							55	09.02.05	176.766	8	62
92	90	1278	E13							52				
93	91	1279	E13							55	10.05.05	185.216	6	46
94	92	1280	E13							51				
95	93	1281	E13							44				
96	94	1289	E13							49				
97	95	1291	E13							58				
98	96	1292	E13							40				
99	97	1294	E13							46				
100	98	1297	E13							47				
101	99	1299	E13							38				

Dateneingabe für CRT-Messungen

Fahrzeugnummer : 1271

Messung Nummer : 2. Prüfung

Datum : 27.04.05
(z.B. 4-1-5 für den 04.01.2005 oder anderes Datumsformat)

Tachostand : 194260

Leerlaufwert : 5 Vollastwert : 37

Übernehmen Beenden (ESC)

Fahrzeugliste 2/3/

Zeichnen AutoFormen

Bereit NF

HJS new regeneration method for CRT systems

Step 1: Heat filter

Step 2: Cool filter

Step 3: Blow out oil ash



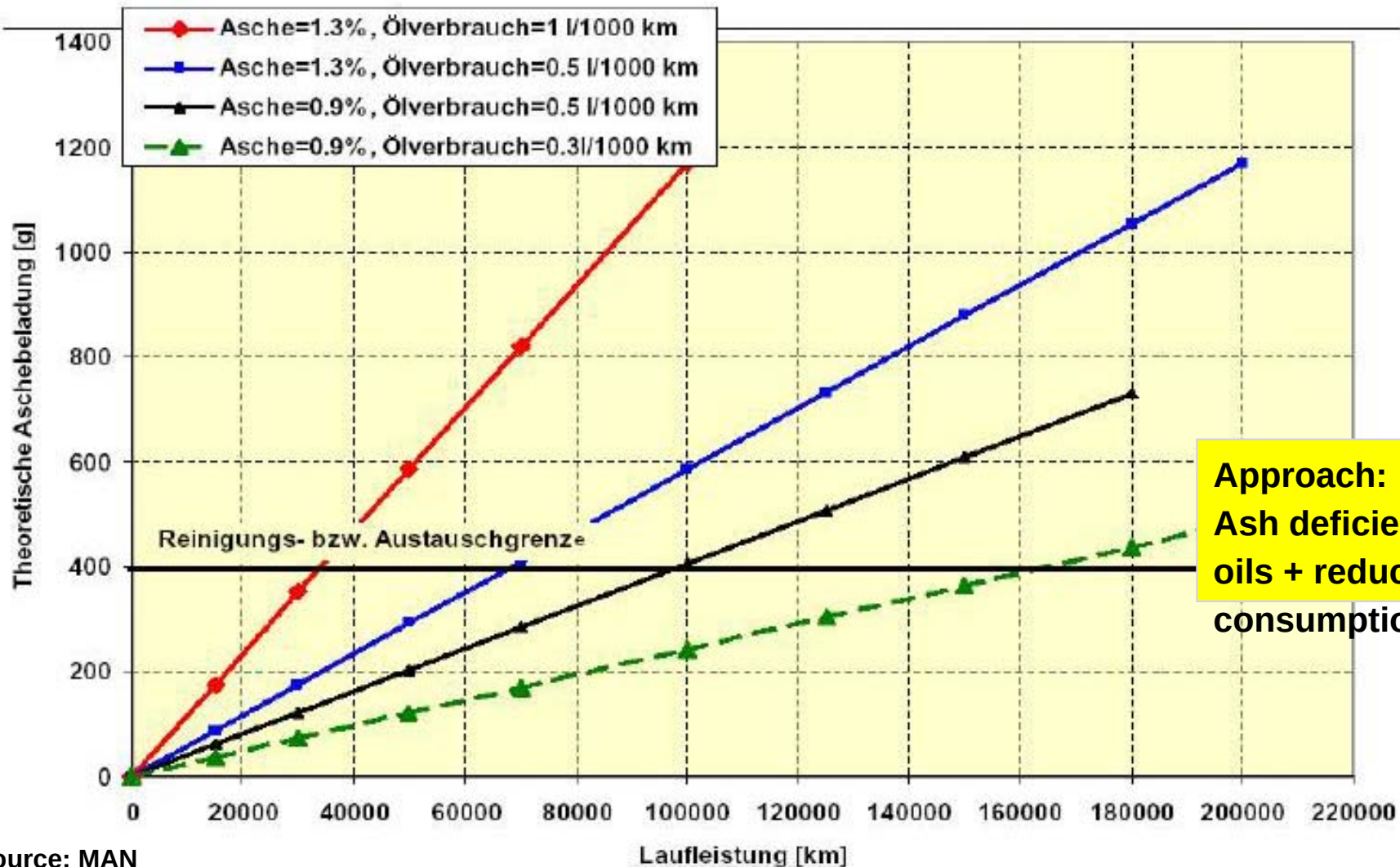
SMF



SMF



Low-ash oils and lower lube consumption prolong cleaning intervals



Approach:
Ash deficient motor
oils + reduced oil
consumption

Source: MAN

Lines are:

- 1.3% ash content at oil consumption 1.0 and 0.5 liters per 1,000 km
- 0.9% ash content at oil consumption 0.5 and 0.3 liters per 1,000 km

Vertical axis is calculated ash burden [g]

Cleaning or replacement recommended at 400g ash burden

Defective CRT filter



CRT costs

	Material cost	Wage cost
CRT retrofitting	5,500 to 7,000 EUR	150 EUR
CRT regeneration		200 EUR

CRT failure	0.5% p.a.
-------------	-----------

„Zeichen 270.1“



BUS

BVG