„Development Status of BGL-Gasification“

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SVZ Schwarze Pumpe

SEKUNDÄRROHSTOFF VERWERTUNGSZENTRUM SCHWARZE PUMPE

Is one of the largest german plants for the utilization of several solid and fluid kinds of waste. Installed capacities:

400,000 tpy solids		**50,000 tpy fluids**	
among them:	***waste plastics***	***among them:***	***oils***
	municipal waste		***tars***
	sewage sludge		***solvents***
	shredder residues		

processed to:	***synthesis gas***	***gypsum***	
	methanol	***power***	***steam***

Is the technology leader of the material use of waste by gasification and methanol synthesis

Is a large scale operator of three types of gasifiers :

entrained flow	***GSP***
slagging	***BGL***
rotating grate	***FDV (Lurgi)***

Favourable Location in the Heart of the New Europe

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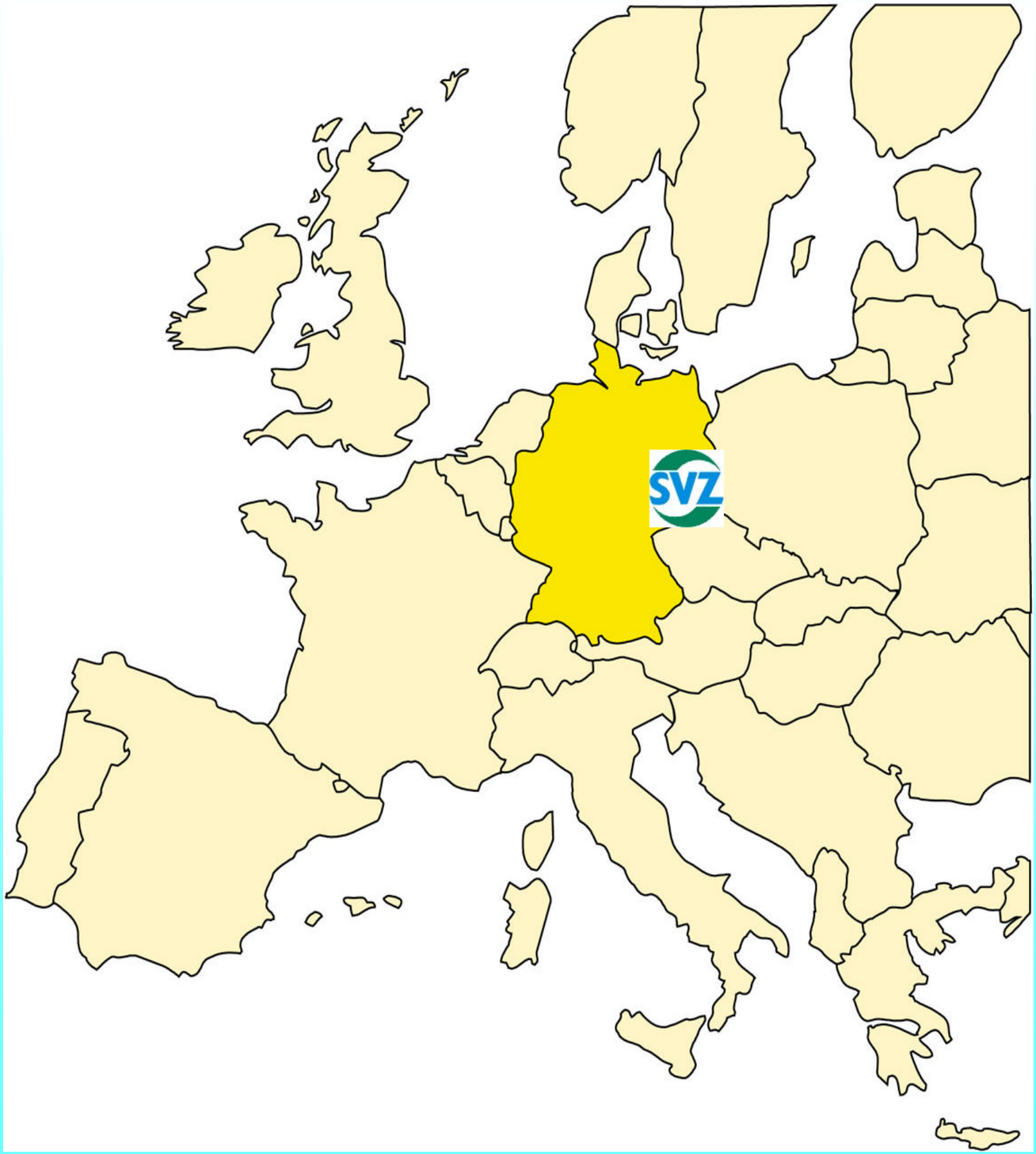

History of Schwarze Pumpe
Construction of the Coal Refining Company

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1955 **Opening of the site**

1959 **Commissioning of the first briquetting factory and the first power station**

1964 **Commissioning of the town gas plant**

1969 **Commissioning of the cokery**

In total	***four power stations***	***(1.500 MW)***
	three briquetting factories	***10 Mio. t/year***
	one cokery	***1.5 Mio. t/year***
	one town gas plant	***5.3 bill. m^3 /year***
	additional plants, workshops etc.	

Input lignite per year : 30,000 000 tonnes **Employees 1990: 13,500**

Historical View on Schwarze Pumpe Site

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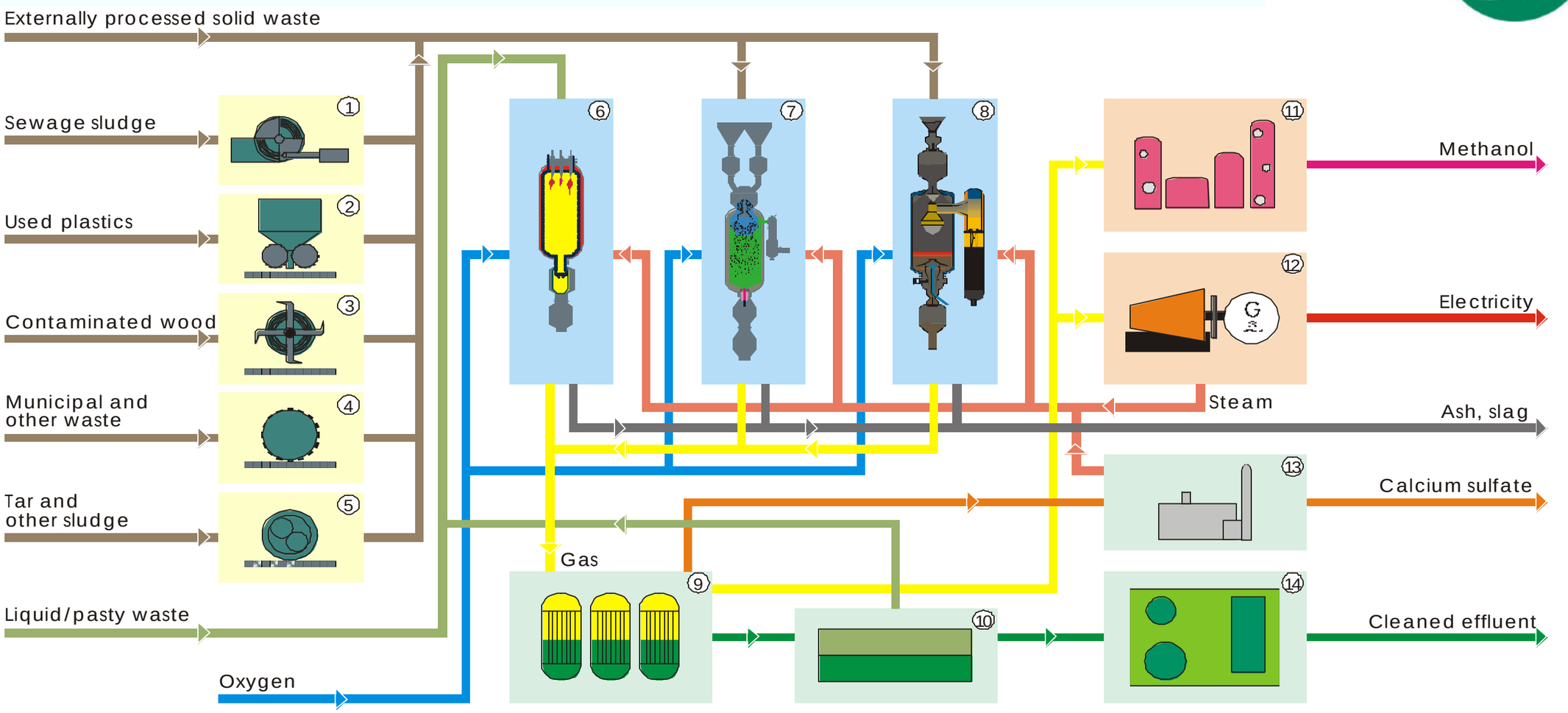
History of the Gasification Plant Schwarze Pumpe

1964	**Start up of the first fixed bed gasifier in the gasification plant Schwarze Pumpe (production of town gas out of lignite briquettes)**
1969	**Finishing of the town gas plant (largest lignite gasification plant worldwide) with 24 gasifiers, production 5.3 billion m^3 /year, 85 % of gas demand of eastern part of Germany (former GDR)**
from 1990	**Re-united Germany: conversion process from town gas to natural gas started, town gas market in the new federal states quickly declined**
from 1992	**New concept for the gasification plant: waste gasification, large scale tests**
from 1995	**Investment: methanol plant, power station, several preparation plants**
2000	**Start up of the new BGL-Gasifier**
2003	**Projects for further extension are applied**
2004	**Running operation under insolvency proceedings**
2005	**Negotiations with Sustec Group, Switzerland, to hand over the operative business on July 1st**

Treatment of solid and liquid waste

SEKUNDÄRROHSTOFF VERWERTUNGSZENTRUM SCHWARZE PUMPE



1. Sewage sludge briquetting
2. Compaction of plastics
3. Wood chopping
4. Waste preparation
5. Pelletising plant
6. Entrained flow gasification
7. BGL gasification
8. Pressurized bed gasification
9. Gas purification
10. Separation of oil/water
11. Methanol production
12. Combined Cycle Gas Turbine
13. Boiler plant
14. Sewage treatment

Agglomeration Technologies at SVZ

• **Extrusion plant for waste plastics**	**25,000 tpy**
• **Briquetting plant for sewage sludges**	**80,000 tpy**
• **Municipal waste pelletizing plant**	**120,000 tpy**
• **Sewage sludge and tar sludge (from “tar lakes“) pelletizing plant**	**120,000 tpy**
• **Chopping plant for wood (stand-by)**	**20,000 tpy**

Quality of Waste Pellets

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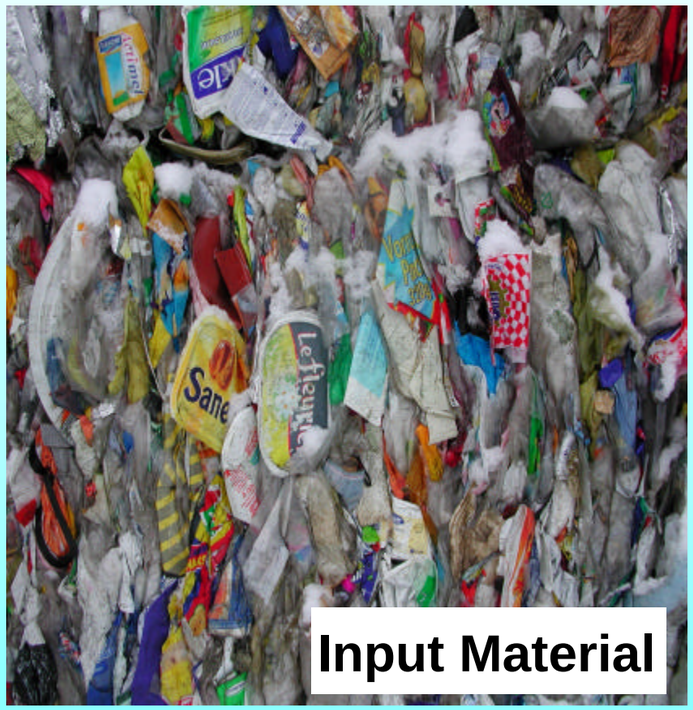
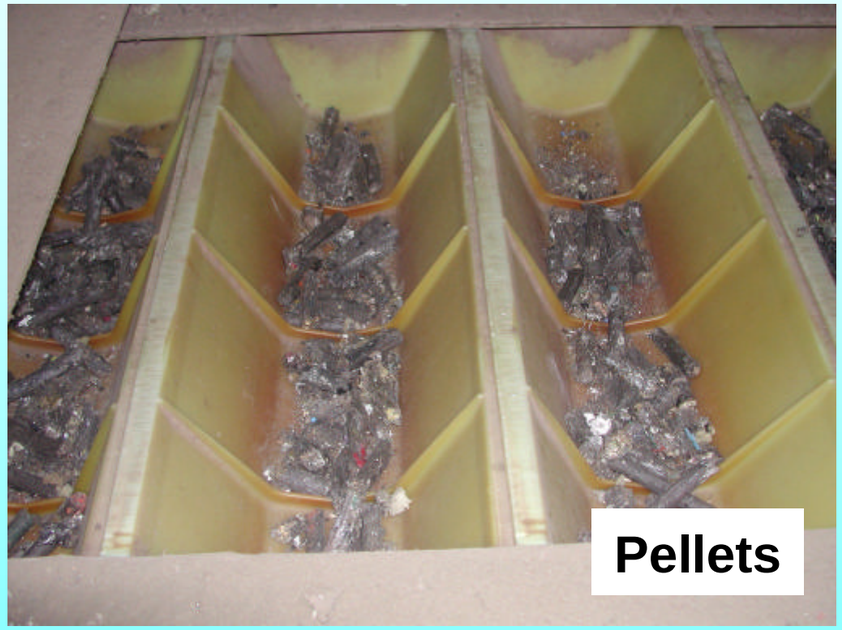


Input Material

Pelletizer



Pellets

- Size requirement: approx. 20 x 80 mm,
  fine particles < 6 mm: to be minimized
- Suitable for transportation and handling
- Thermal stability up to gasification temperatures

Waste Pelletizing

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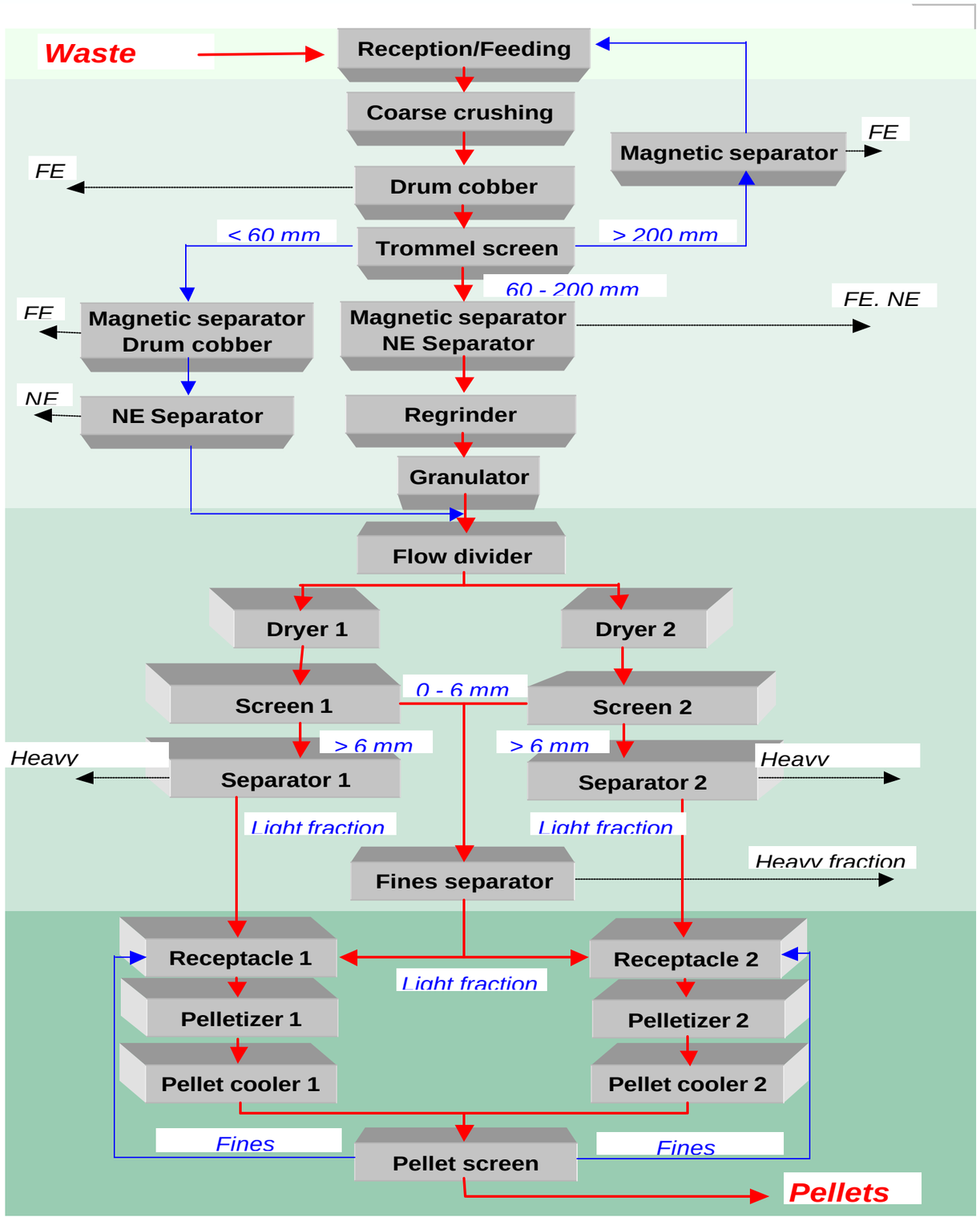

Utilization of Solid Waste
Maximum Concentration of Pollutants

Arsenik	mg/kg	2 000
Lead	mg/kg	10 000
Cadmium	mg/kg	1 000
Chromium	mg/kg	20 000
Copper	mg/kg	100 000
Nickel	mg/kg	5 000
Mercury	mg/kg	200
Zink	mg/kg	100 000
Tin	mg/kg	10 000
Cyanide	mg/kg	500
Polychlorated biphenyls	mg/kg	500
Chlorine/ Halogene	mass%	10
Dioxins/ Furans	µg TU/kg	50

Waste materials processed at SVZ
(From June 1992 until May 2005)

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Solids

Used plastics	**900,000 t**
Sewage sludge	**120,000 t**
Contaminated wood	**225,000 t**
Treated domestic waste (RDF)	**295,000 t**
Pellets from tar and sewage sludge	**160,000 t**
Shredder residue	**20,000 t**
Others	**95,000 t**

Fluids

Contaminated oils, Oil-/water mixtures	**1,300,000 t**
Mixtures from solvents	

Gasification Plant

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VERWERTUNGSZENTRUM
SCHWARZE PUMPE

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Chemical Reactions of Gasification

$2C + O_2 \rightarrow 2CO$

$H_2O + C \rightarrow CO + H_2$

$2H_2O + C \rightarrow CO_2 + 2H_2$

$C + 2H_2 \rightarrow CH_4$

Chemical Reactions of Methanol Synthesis

$2H_2 + CO \rightarrow CH_3OH$

$3H_2 + CO_2 \rightarrow CH_3OH + H_2O$

Composition of Syngas (after Gas Cleaning)

H_2	64,1	Vol.-%
CO	19,6	Vol.-%
CO_2	6,3	Vol.-%
CH_4	8,4	Vol.-%
N_2	1,4	Vol.-%
O_2	0,06	Vol.-%
C_nHm	0,12	Vol.-%
H_2S	<0,05	mg/Nm3

Heating value
12.000 - 15.000 kJ/Nm^3

Gas Cleaning, Methanol Plant, Power Station

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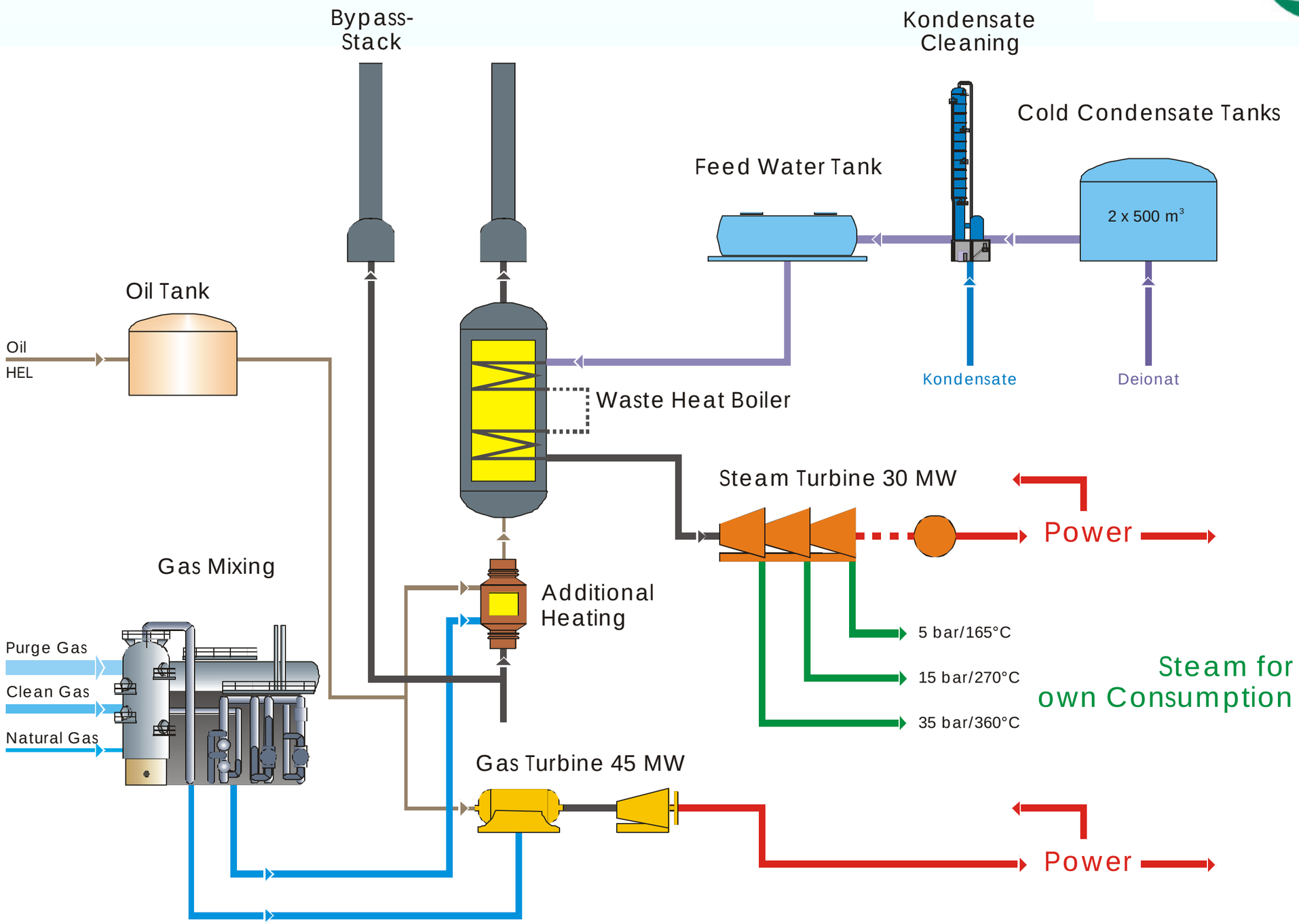
VERWERTUNGSZENTRUM
SCHWARZE PUMPE
SVZ

Flow Scheme Power Station



Flow Scheme Methanol Plant

SEKUNDÄRROHSTOFF VERWERTUNGSZENTRUM SCHWARZE PUMPE

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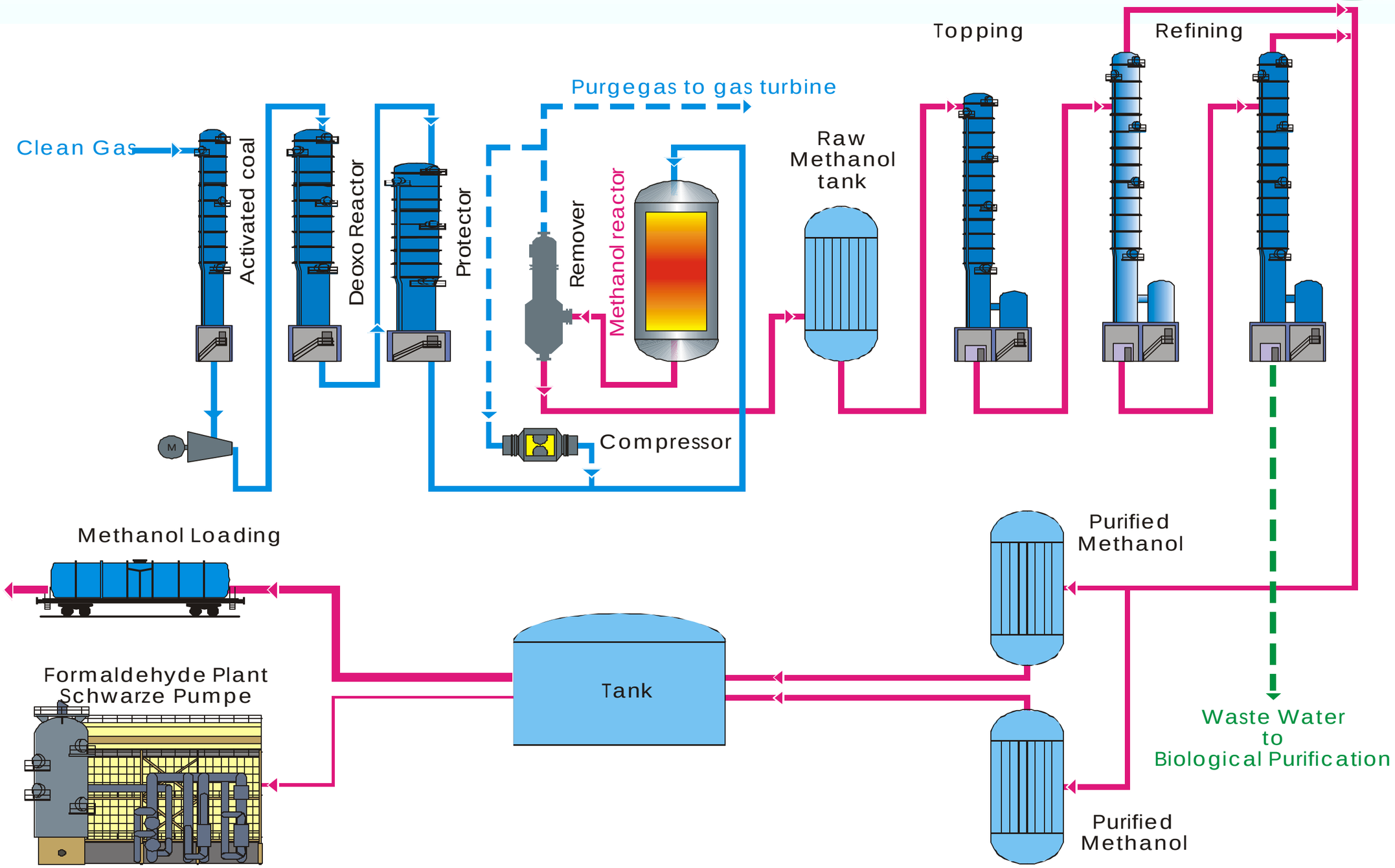

Opportunities for the Use of the Synthesis Gas

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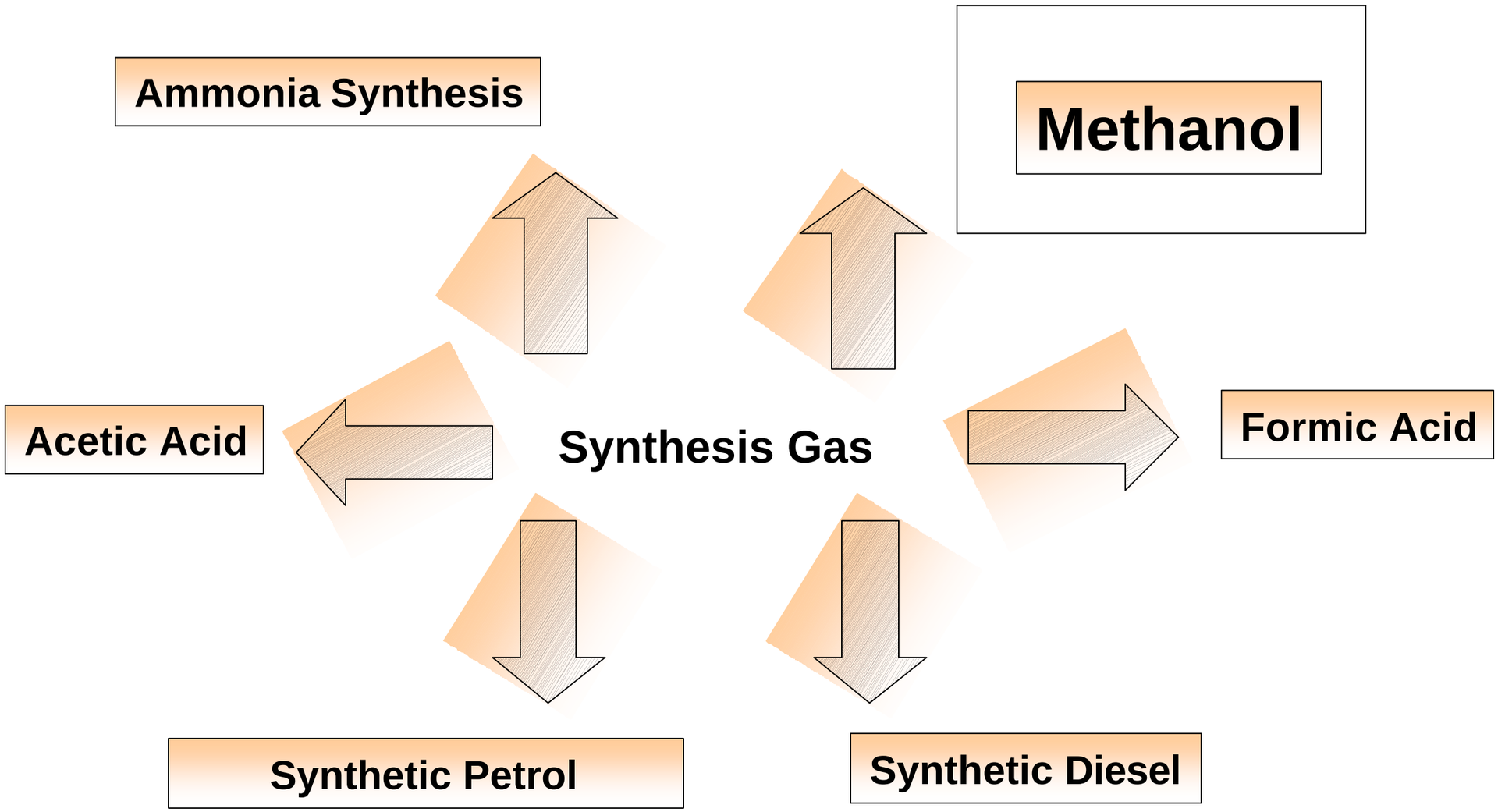

Application of Methanol

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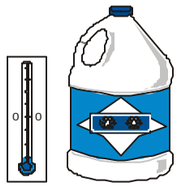
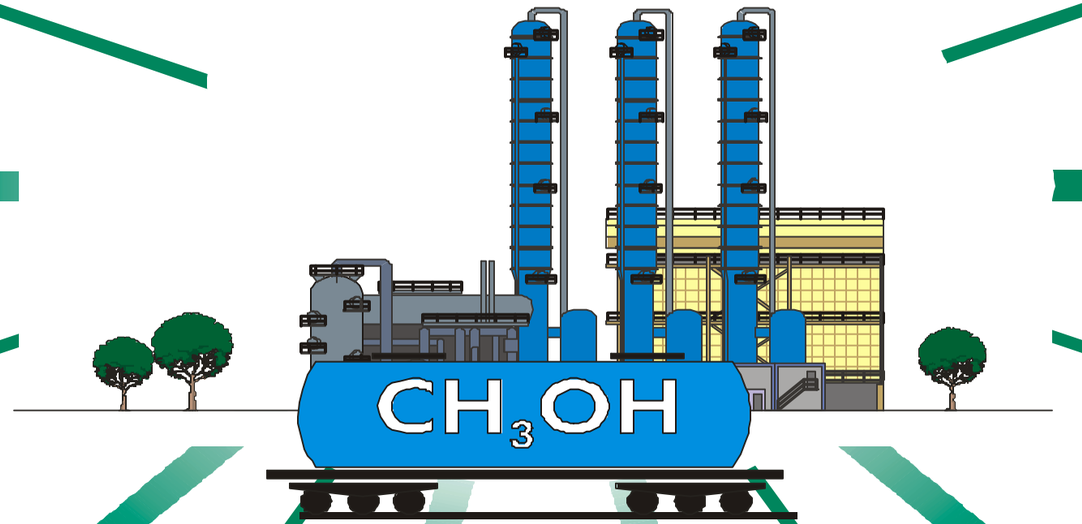
Selected areas of application for methanol

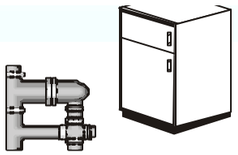
Methylating agents
- Pharmaceuticals
- Paints
- Absorbing agents



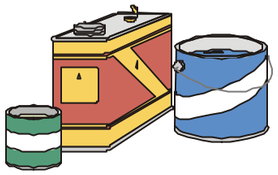
Antifreeze

Acetic acid

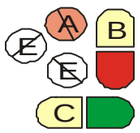




Cooling agents in refrigerating plants



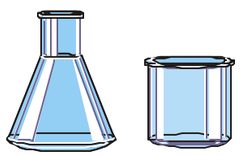
Solvents
- for resins and waxes
- inorganic salts
- polymers



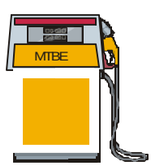
Vitamin products

Formaldehyde
- Phenolic resins
- Urea resins
- Melamine resins
- Wood preservatives
- Disinfectants
  etc., etc.

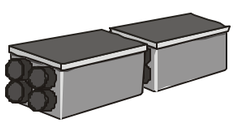
Chemical synthesis
- for insecticides
- for explosives
- for scents
- for plexiglass
  etc., etc.



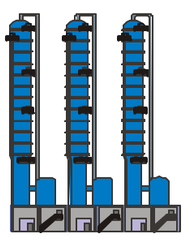
Denaturants



MTBE
Anti-knocking agent
for gasoline



Fuel cells



Low-temperature gas washing

SVZ-Methanol Quality

The quality of the methanol produced by SVZ meets international standards (ASTM, IMPCA).
Grade AA- Methanol, Highest purity > 99,9 %

SVZ-Methanol is used by DaimlerChrysler

(Fuel Cell Car)

Results of Waste Treatment

	Heating value	Water	Ash	Methanol output	Reduced CO_2 Emmissions (compared with incineration)	Energy efficiency	Power surplus
	MJ/kg	Mass %	Mass %	Kg per ton waste	%	%	MWhr
Used plastics	**33,7**	**1,5**	**7,8**	**596**	**32**	**47,5**	**0,23**
Contaminated wood	**16,8**	**1**	**11**	**357**	**34**	**50,4**	**0,21**
Domestic Waste (RDF)	**18**	**4,5**	**20**	**392**	**31,5**	**46,6**	**0,23**
Shredded material	**11**	**7,5**	**43,8**	**211**	**24**	**38**	**0,04**
Sewage sludge	**11**	**8**	**43,5**	**160**	**21**	**35**	**0,03**

SVZ-Process – Ecological Advantages

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1 Waste gasification to produce methanol and energy saves fossil fuels and materials

2 As a result of recycling activities we get substantial reduction of waste volumes and savings of landfill space

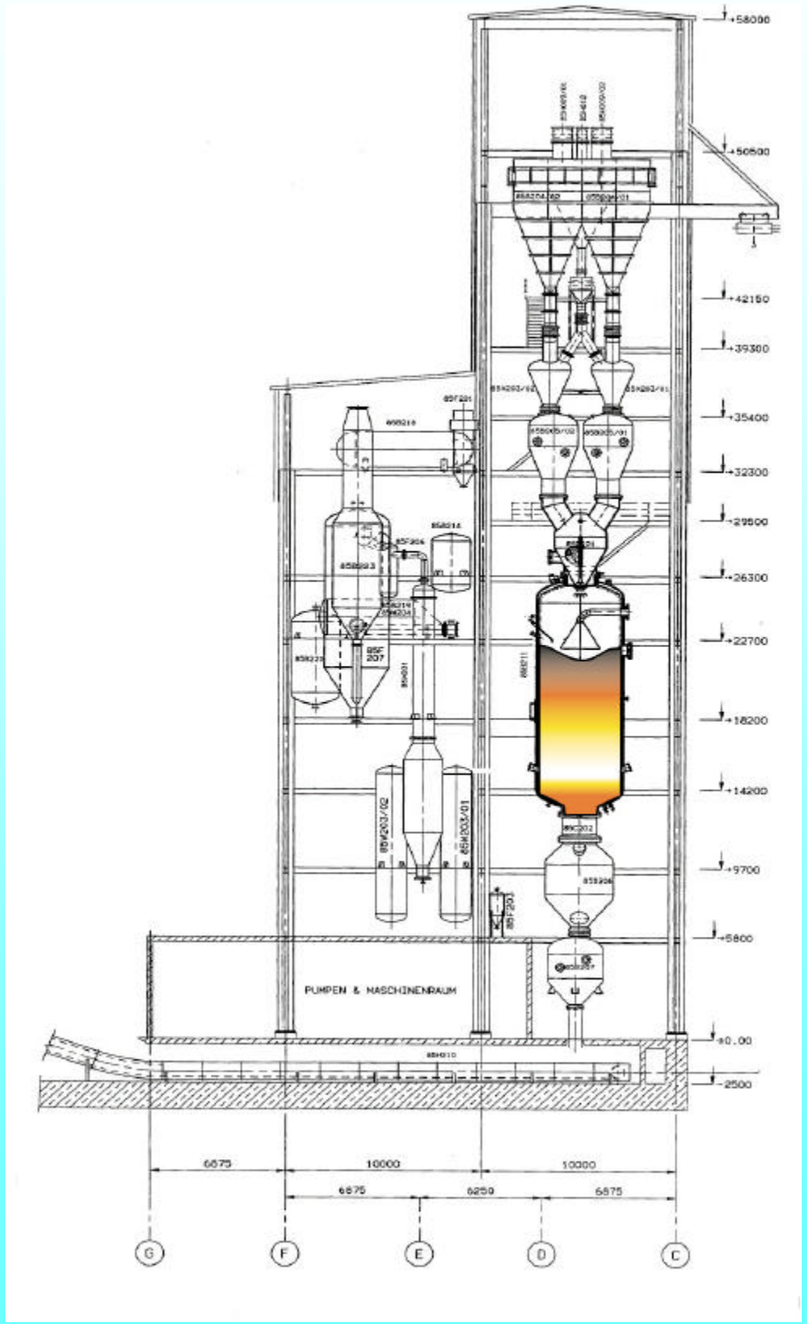
3 High temperatures of gasification (1,450 °C till 1,800°C) destroy organic pollutants (dioxines and furanes)

4 Heavy metals or other hazardous materials of the several kinds of waste are contained in the gasifier slag

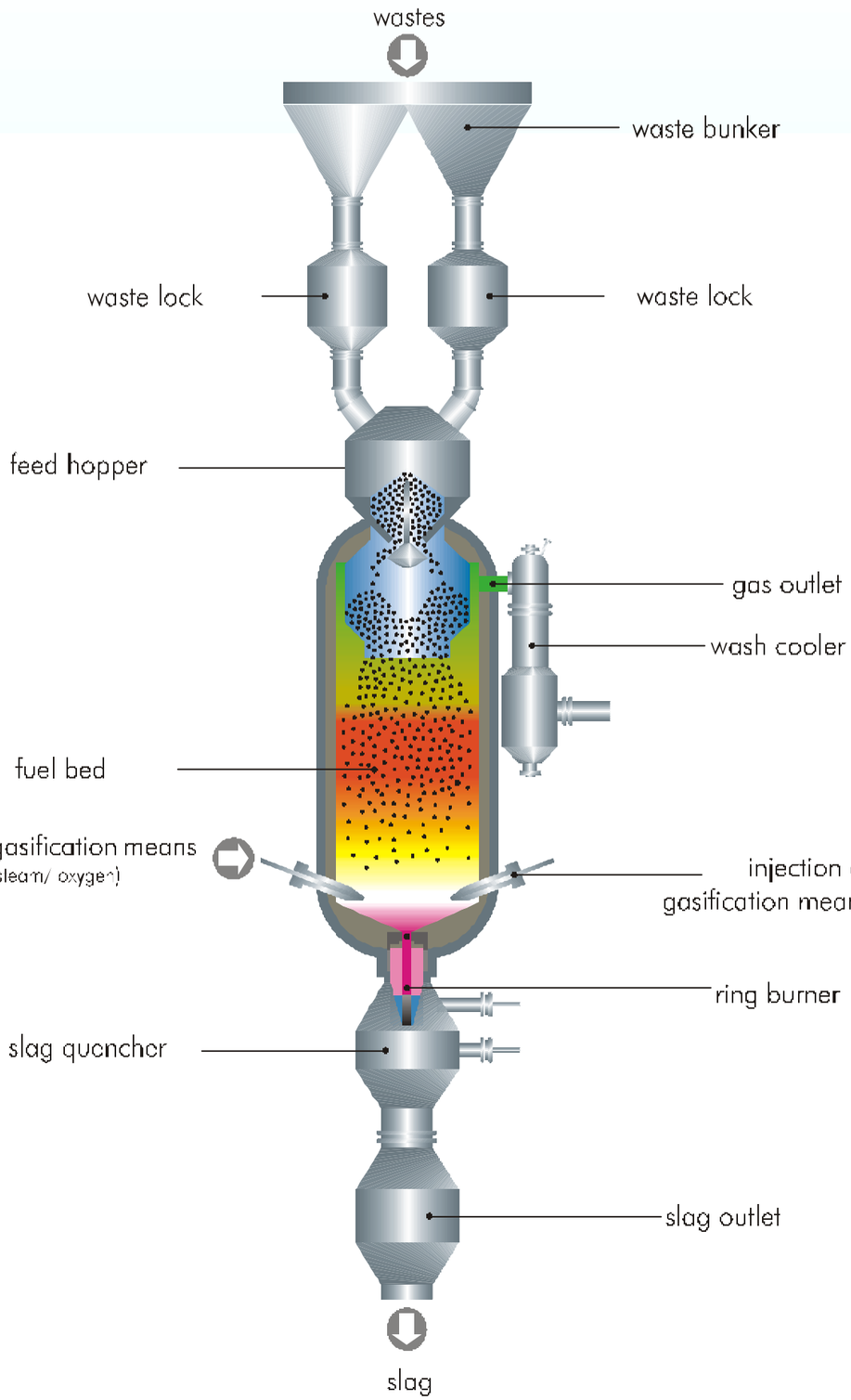
5 The slag can be used as material for road construction or as additive for special materials

6 In comparison to incineration the feedstock-recycling contributes to the CO_2-reduction by integration of the carbon contents of the waste into methanol

BGL-Gasifier at SVZ



Slagging Gasifier BGL



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- **British Gas - Lurgi Gasification (BGL)**

  – **System datas**
    - **Diameter 3.6 m**
    - **Pressure 25 bar**
    - **Double jacket water cooled**
    - **Inlet of gasification mean by jets**
    - **Fluid slag outlet with quenching system**

  – **Operation datas**

Throughput	**35 t/h**
Series of input	**6 - 9 /h**
Gas quantity	**35,000 Nm³/hr**
Temperature	**1,600 °C**
Oxygen	**6,000 Nm³/hr**
Steam	**6-9 t/hr**
Slag	**£ 7.5 t/hr**
Gas outlet	**500-700 °C**

- **temperature after scrubbing < 200 °C**

Commons and Differences between Fixed Bed Gasifier and BGL-Gasifier

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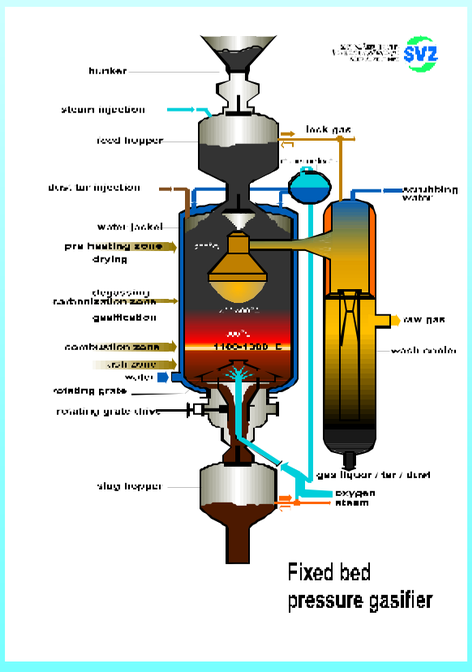
In Schwarze Pumpe since 1964 fixed bed gasifiers with rotating grate have been in operation: during peak periods 24 pieces for coal gasification and town gas production with a high degree of reliability.
Until 1995 seven gasifiers were adapt to waste gasification.
Nevertheless 1995 SVZ decided to errect a new BGL-Gasifier to use the advatages of the new technology.

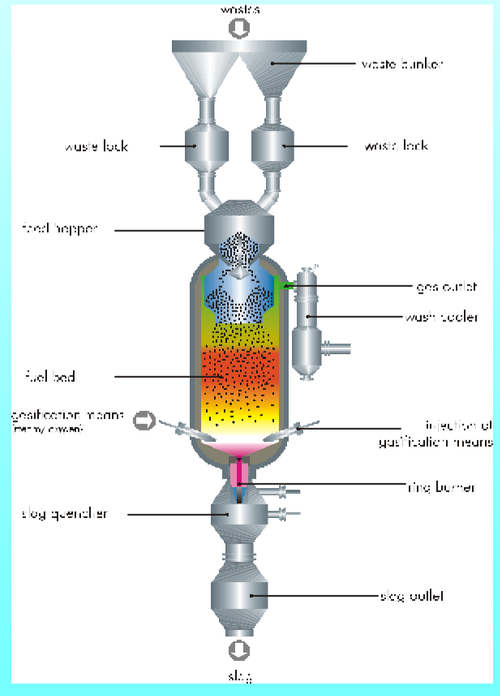


Differences:

- Reduced steam consumption of BGL
- Vitrified slag of BGL (Fixed Bed: sintered ash)
- Higher temperatures of BGL
- Higher specific throughput of BGL
- Differences in gas composition

Commons:

- Originally designed for coal gasification
- Countercurrent flow of gas and solid fuels
- Input of fuel through lock system
- Gasification agent: steam and oxygen
- Internal diameter 3,6 m
- Pressure 25 bar



Gas Composition

		BGL-Gasifier		FDV-Gasifier
		Operation with high waste addings	Operation with coal (Start up)	Operation with high waste addings
H_2	Vol.-%	18,0	28,0	26,0
CO	Vol.-%	33,5	56,0	11,0
CO_2	Vol.-%	16,0	2,8	39,6
CH_4	Vol.-%	18	6,0	14
N_2	Vol.-%	10	6,0	2
O_2	Vol.-%	0,3	0,1	0,2
C_2H_6	Vol.-%	2,2	0,4	4,0
C_2H_4	Vol.-%	0,6	0,1	1,5
C_3H_8	Vol.-%	0,3	<0,05	0,4
C_3H_6	Vol.-%	0,4	<0,05	0,5
i-C_4H_{10}	Vol.-%	< 0,05	<0,01	< 0,05
n-C_4H_{10}	Vol.-%	< 0,05	<0,01	< 0,05
H_2S	Vol.-%	0,2	0,3	0,2
BTEX-Flavours	Vol.-%	0,5	0,3	0,6
Density	kg/Nm³	1,1	0,9	1,2
Calorific Value	MJ/Nm³	15,8	13,0	14,4

Operational Datas II

Typical admixing rates of several kinds of waste:

Plastics	**5 ... 50 %**	**MSW Pellets**	**5 ... 50 %**
Tar-Sludge Pellets	**5 ... 25 %**	**Contam. Wood**	**5 ... 15 %**
Special Inputs *(WEEE, Pellets from paintings, roofing felt, ...)*			**5 ... 10 %**

•**admixing rate** **(part of waste in the total input)**	until **80 %**
•**ash-content in the total input**	between **10 ... 25 %**
•**total troughput** ***(depending from performance and input material)***	until **36 t/hr**
•**crude gas quantities**	between **25,000 ... 35,000 Nm^3_{dry}/hr**
•**range of capacity**	between **4,000 and 6,000 m^3 O_2/hr**

Large Scale Test 2003
Material Recycling of Shredder Residue

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930 t
Automotive Shredder Residue
(ASR)

+

930 t
Municipal Waste
(MSW)

Pellet Production (ASR/MSW)

Gasification in the slagging gasifier (BGL)

3 days period, max. 33 t/hr
50 wt.-% ASR/MSW-Pellets , 30 wt.- % mixed plastics, 20 wt.-% coal
that means: Shredder Residue 25 wt.-% (8,25 t/hr)

crude gas output: 32,000 Nm^3/hr

Official Status as material recycler

Large Scale test 2005, Material Recycling of WEEE

- admixing rate in WEEE/MSW-Pellets:	**32,5%**
- admixing rate in BGL-gasifier:	**about 50 wt.-% WEEE/MSW-Pellets (that means 15 wt -% WEEE)**
- stable run of the plant	
- troughput BGL-Gasifier:	**26 t/hr**
	among them 13 t/hr WEEE/MSW - Pellets
- crude gas output:	**about 25,000 m³ /hr**

Further Developments to Improve the Aviability

Problem	Solution
▪ Cloggings of the slag water cooler	▪ New design and manufacturing of larger slag water coolers
▪ Cloggings at the slag outlet	▪ Decreasing of heat losses by installation of SiC-cone at the slag outlet nozzle and optimization of coolings ▪ Installation to pick out metals from the loading belts
▪ Edge life of the nozzles for the gasification agent	▪ Double coating of the nozzle heads with suitable wear resistant material
▪ Stability of the fill-in shaft	▪ New design of the fill-in shaft and installation of thermostable material to improve the mechanical and thermal stability
▪ Loading problems (rolling of material)	▪ Changes in the outlet-geometry of the feed hopper and control optimization of the waste/coal input
▪ Range of capacity of the plant	▪ Improvement of the control and adaption to the oxygen input to the requirements of the compound operation
▪ Additions of coke-like material in the upper part of the gasifier (specially on the crude gas outlet)	▪ Cooling of the upper part by specific water jets

SVZ Future Prospects and Visions

Rising oil and gas prices and worlwide interest in stability and reliability of energy supply will lead to a revival of coal chemical industry.

Schwarze Pumpe has best conditions for technological leadership in this field because of the long standing experience and the large scale operation.

The Sustec Group as the probable new owner of SVZ has announced financial restructuring and extensive investments on the Schwarze Pumpe site:

- **installation of a new coal gasification (based on GSP-process)**
- **extension of the methanol production**

The aim is to demonstrate the competiteveness and the technology leadership in coal and waste gasification.

Thank you for your kind attention

My Colleagues and I are available to further discussions.

For more and detailled information about SVZ and BGL operation we recommend the

Technical Tour to Schwarze Pumpe.

(Saturday, 18th of June 2005)