C E M
C O N

RECYCLING OF WASTE DERIVED MATERIALS IN THE CEMENT INDUSTRY

A BENEFIT TO THE ECONOMY, THE ENVIRONMENT AND THE SOCIETY

Dr. Hans Wilhelm Meyer
CEMCON AG
BERN, SWITZERLAND

INTRODUCTION

- Within the Cement Industry of Central Europe, Japan and the North America 40 % - 60 % of primary fuels like gas, coal or oil are substituted by so called secondary-, alternate- or waste derived fuels (WDF). But WDF is not the correct specification as the materials are not only combusted but also indirectly recycled into a new product, - the Cement.

- No negative influence on the properties of the cement and its application occurs.

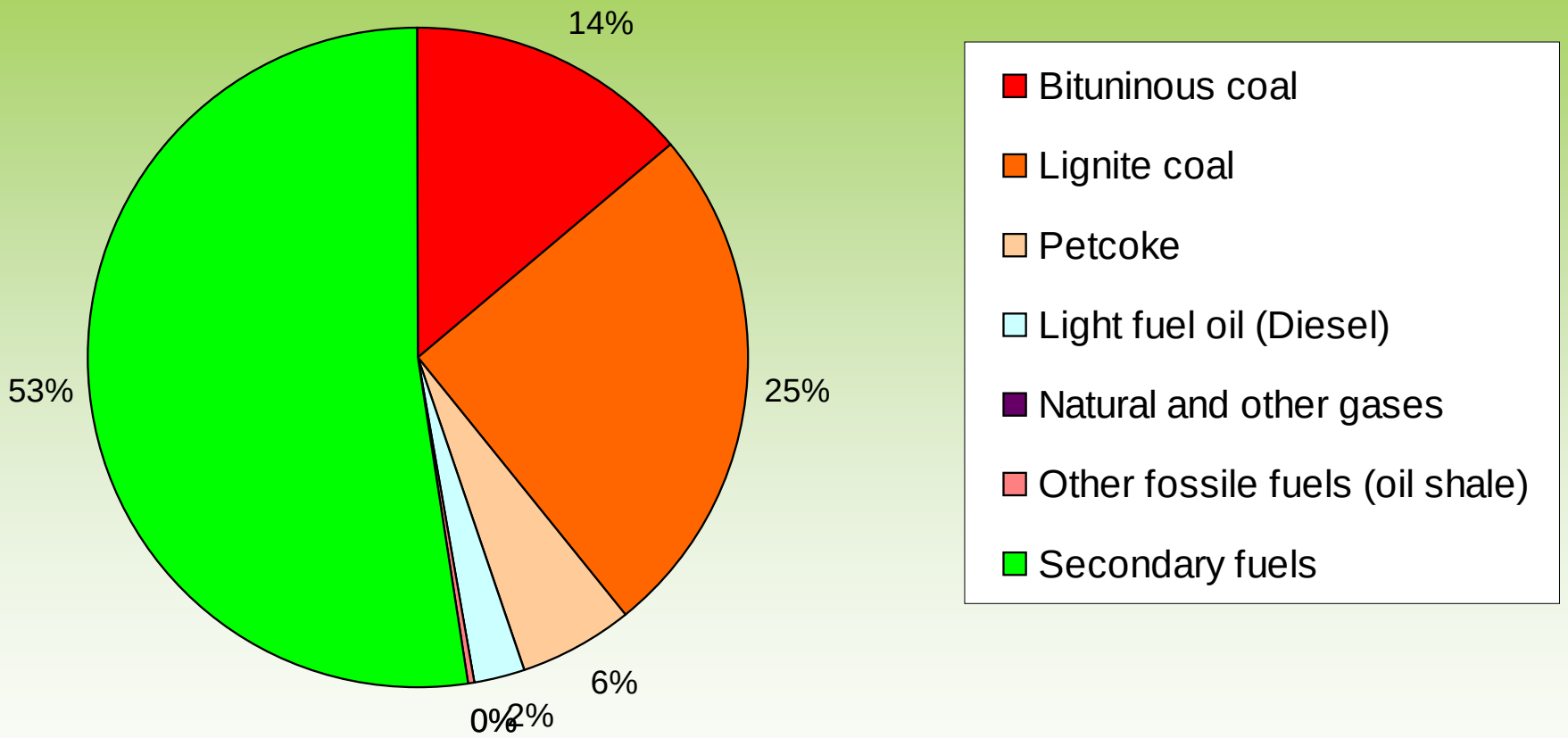
- Based on a 4500 tpd cement plant, like the new Akmenes Cementas production line in Lithuania with a specific heat consumption of 760 kcal/kg clinker and a specific calorific value of 3500 kcal/kg for the waste derived materials and a substitution rate of 50 % the following processing and recycling figures could be achieved:

Substitution of coal per day*	Recycling of WDF per day*	Substitution of coal per year*	Recycling of WDF per year*
T	T	T	T
305	488	**97.600**	**156.160**

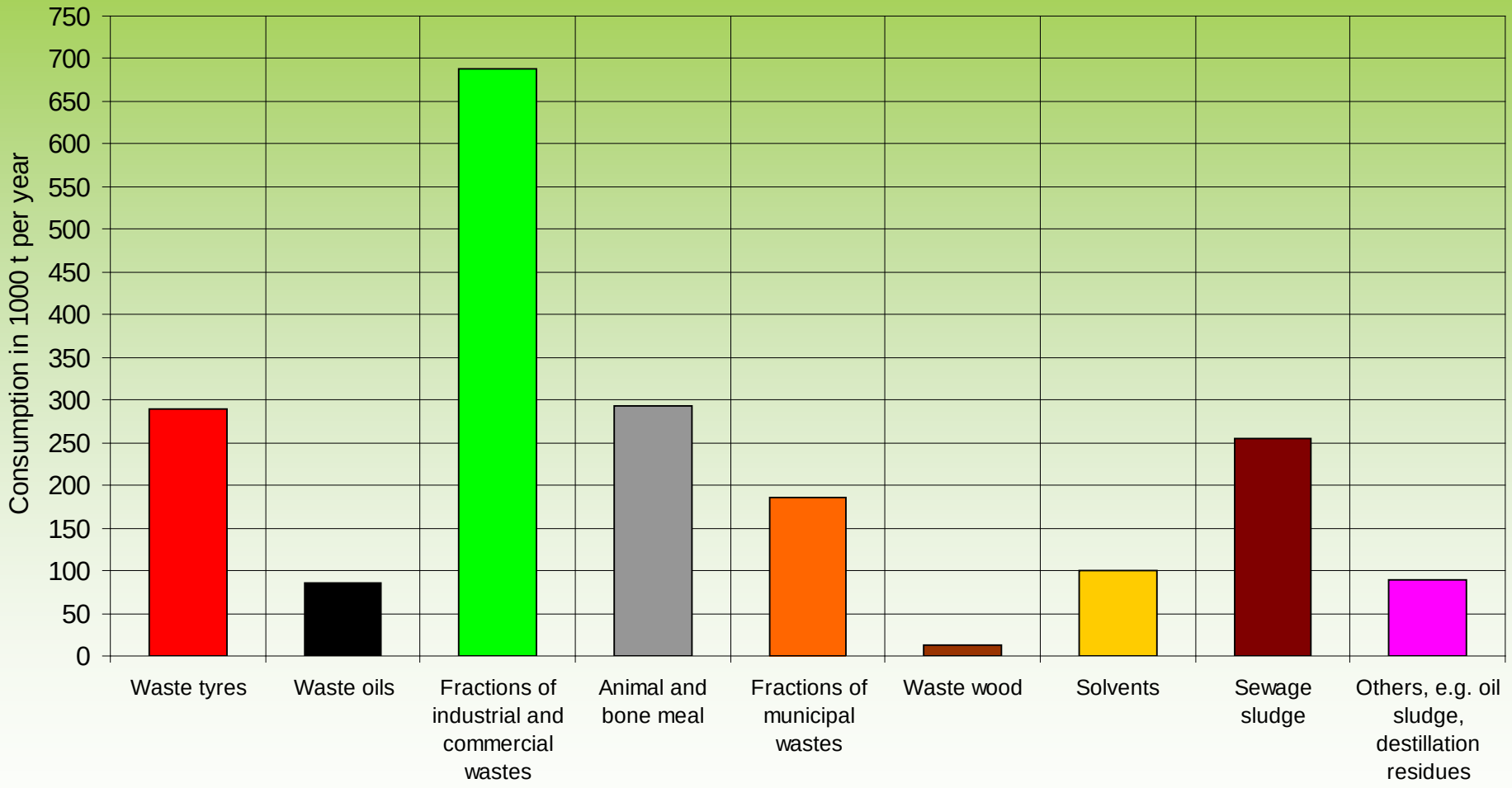
* Based on 320 days of operation per year and a specific calorific value of coal of 5600 kcal/kg

- **Based on the above facts the Cement Industry is an essential key factor in the Waste Management System of all Western Countries for a safe and environmental friendly recycling of waste derived materials.**

Total Fuel Consumption within the German Cement Industry in 2007



Break up of Waste Derived Materials Recycled in the German Cement Industry in 2007



Options of Waste Material Handling

Landfill of waste materials

- Consumption of land
- Only limited suitable deposit areas available
- Even most modern landfill technologies can not prevent contamination of ground water and/or emission of methane

Consequence:

Landfills are closed and not considered as a future solution

Waste material incineration

- Waste incineration plants are investment intensive with a long ROI
- Incineration is expensive to the the public
- Environmental problems (heavy metals, dioxins, furans & ash disposal)

Consequence:

Waste incineration plants should be replaced by recycling concepts

Co-processing in cement plant

- Cost efficient for the public
- Environmentally friendly solution with almost no emission of heavy metals, dioxins and furans
- Production of a valuable good, savings of imported fossile fuels and reduction of CO_2 emissions

Consequence:

Integrated part of the general waste management and recycling concept (direct and indirect recycling)

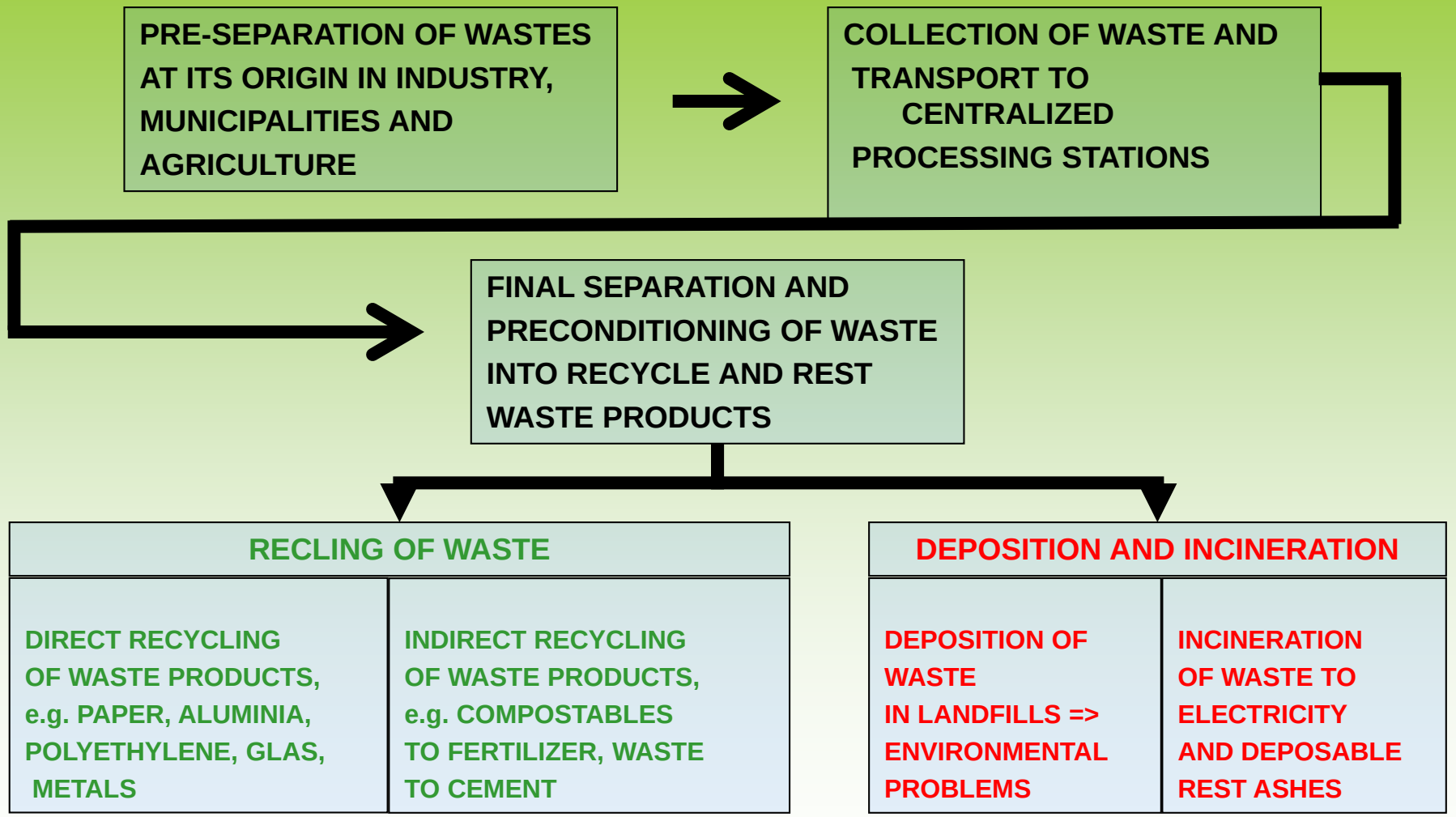
C E M
C O N

Comparison of Waste Processing in Cement Production of Waste Incineration

SUBJECT	WASTE COPROCESSING IN THE CEMENT PLANT	WASTE PROCESSING IN THE INCINERATION PLANT
SAVINGS OF PRIMARY FUELS (COAL, GAS, OIL)	100 % SUBSTITUTION OF PRIMARY FUEL ACCORDING TO THE CALORIFIC VALUE OF THE WASTE	ADDITION OF PRIMARY FUEL (OIL OR GAS) NECESSARY FOR IGNITION AND COMPLETE COMBUSTION OF THE WASTE
ANORGANICAL COMPOUNDS OF WASTE (ASHES)	ASHES ARE COMPLETELY RECYCLED INTO THE PRODUCT CLINKER AND CEMENT	ASHES HAVE TO BE PROCESSED OR IN MOST CASES DEPOSED IN LANDFILLS
HEAVY METAL CONTENT OF WASTE AND RELATED EMISSIONS	DUE TO THE ALKALINITY OF THE PROCESS COMPLETE IMMOBILIZATION OF HEAVY METALS IN THE CRYSTAL STRUCTURE OF CLINKER (EXCEPT MERCURY)	HEAVY METALS WILL BE MAINLY EVAPORATED AND EXTREMELY EXPENSIVE AND COMPLICATED FILTERING AND WASHING SYSTEMS HAVE TO BE INSTALLED
FORMATION OF DIOXINS AND FUARANS BY CHLORINE AND FLOURINE COMPOUNDS IN THE WASTE	COMBUSTION AT 1450 °C WITH COMPLETE CRACKING OF ALL ORANICAL COMPOUNDS INTO THE BASE MOLECULE „METHANE“. TIME WINDOW OF DENOVOSYNTHESIS OF DIOXINS NEGLECTABLE	COMBUSTION AT APPR. 850 °C WITH HIGH RETENTION TIME FOR COMPLETE COMBUSTION. TIME WINDOW FOR DENOVOSYNTHSIS OF DIOXINS AND FURANS HIGH. AFTER-BURNING OF WASTE GAS SOMETIMES NECESSARY
TRANSPORTATION OF WASTE	CEMENT PLANTS ARE LOCATED AT THE SOURCE OF LIMESTONE. TRANSPORTATION IS NECESSARY	WASTE INCINERATION PLANTS ARE INSTALLED AT THE SOURCE OF THE WASTE

C E M
C O N

Structure and Function of a Sophisticated Waste Management System (WMS)



Classification of Waste Derived Materials

WASTE DERIVED MATERIALS

No deduc-tion from CO_2-balance

Deduction from CO_2-balance

NON RE-GENERATABLE MATERIALS

INDUSTRIAL WASTES

Solid, e.g.

- Electronical waste
- Waste plastic
- Crating materials
- Tires/Tire chips

Liquid, e.g.

- Used lubricants
- Photo chemical wastes

MUNICIPAL WASTES

(sorted and unsorted)

Solid, e.g.

- Plastic waste
- Sewage sludge
- Food rests

RE-GENERATABLE MATERIALS

AGRICULTURAL WASTES

Solid, e.g.

- Wood chips
- Saw dust
- Agricultural husks
- Raps oil resins
- Animal and bone meal

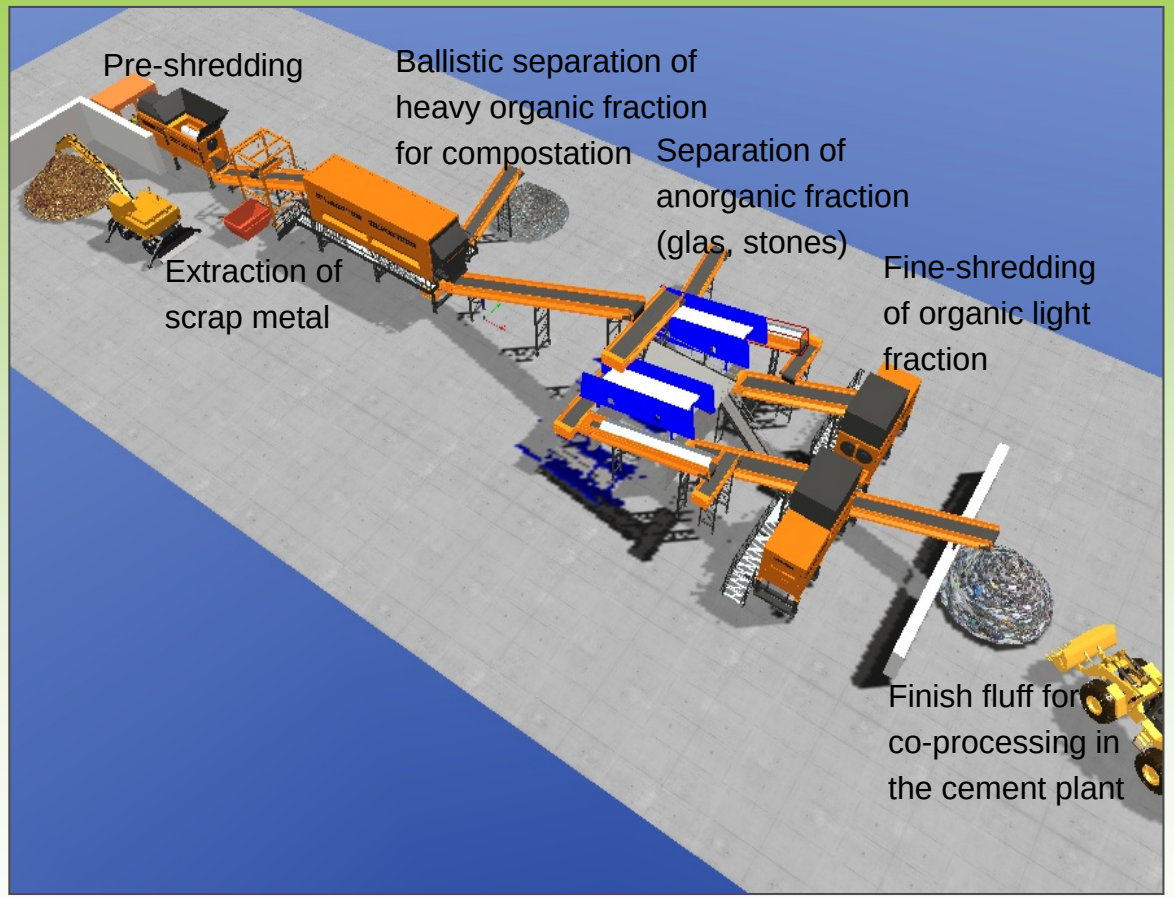
Liquid, e.g.

- Sun flower oil rests
- Raps oil

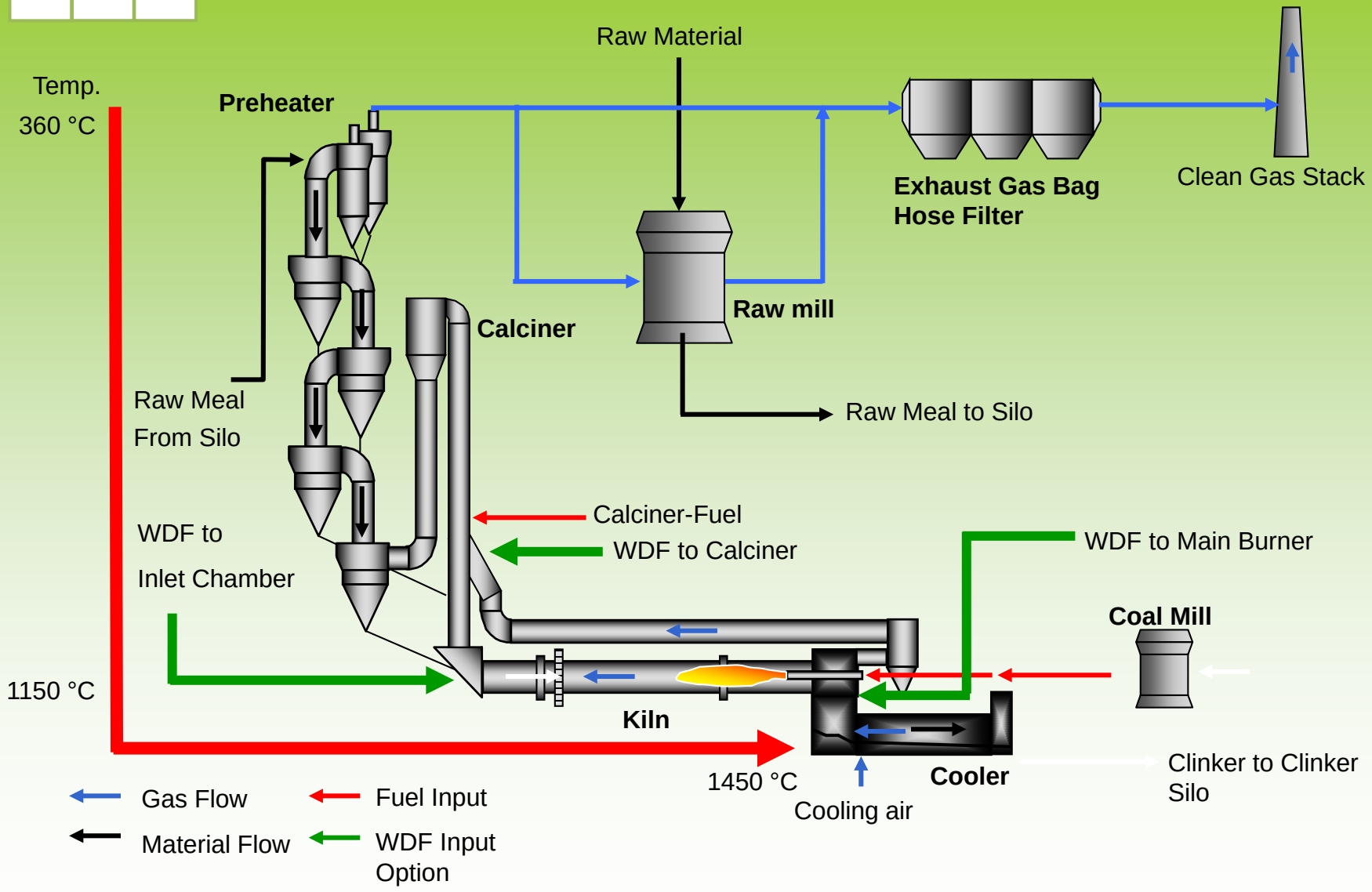
Gaseous, e.g.

- Bio gas
- Compostation gas

Example: Preparation of Municipal-, Industrial Waste Materials or Biomass



Co-processing of Waste Derived Materials in Clinker Manufacturing Process



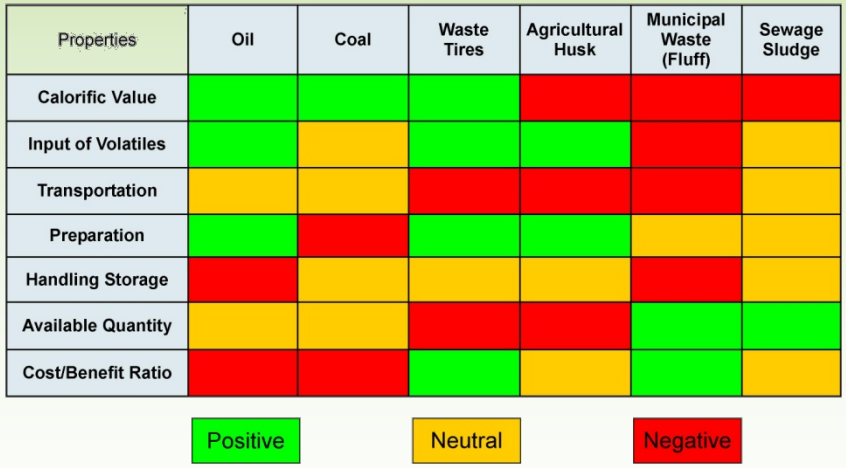
Identification of Sources and Determination of Properties of AFR

Investigation of possible sources of AFR in the range of availability of a particular cement plant:

- Industrial facilities, e.g. refineries, paint manufacturing plants, waste collection companies
- Municipal waste management systems, e.g. disposal companies, water treatment plants
- Agricultural facilities, e.g. husk materials, wood saw mills, bone and animal meal

Listing of all the available types and the quantities as well as the potential seasonal fluctuation of the AFR.

Determimation of all the relevant physical and chemical properties of the identified AFR.



Elaboration of suitable application scenarios based on the physical and chemical properties and commercial aspects whilst considering the particular technology and process requirements of the cement plant and the availability of the AFR.

C E M
C O N

Steps of Implemenation of an AFR Project in a Cement Plant

1) IDENTIFICATION OF SOURCES AND DETERMINATION OF PROPERTIES OF AVAILABLE AFR

2) TECHNO-COMMERCIAL FEASIBILITY STUDY AND PERMIT PROCESSING

3) COOPERATION WITH LOCAL WASTE MANAGEMENT SYSTEMS, INDUSTRIES AND COMMUNITIES

4) DESIGN AND INSTALLATION OF FLEXIBLE PREPARATION, HANDLING, DOSING AND FEEDING TECHNOLOGY

5) CONSIDERATION OF SIDE EFFECTS AND ADJUSTMENT OF THE PLANTS PROCESS AND OPERATION

6) IMPLEMENTATION OF AN AFR MANAGEMENT SYSTEM WITHIN THE CEMENT COMPANY

Typical Scenario for Co-processing of Waste Derived Materials in State of the Art Clinker Production Line

	UNIT	FLUFF	FLUFF	SLUDGE	TYRES	WASTE OIL
Quantity	tpa	87,500	175,000	129,800	12,500	4,000
Substitution rate	%	20	40	6.4	7.0	2.7
Disposal Fee for 3-years of ROI	€/T	18.5	6.0	37.7	N/A	14.60 (cost) delivered
Reduction of petcoke consumption	tpy	31.104	62.208	9.953	10.886	4.199
ROI – At no disposal fee	years	5.6	3.8	11.7	1.3	2.6

Total co-processing rate of Waste Derived Materials: 56.1 %

C E M
C O N

Conclusion

- The cement manufacturing is a key figure for the growth and the development of a country.
- The cement production is the second most energy consuming large scale industrial process (ranging between aluminium and steel production).
- Due to its process and production properties practically all kinds of waste derived materials (solid, liquid or gaseous) can be properly recycled within the clinker production process.
- The clinker production process offers significant advantages compared to waste incineration and guarantees an environmental friendly processing of waste derived materials.
- Waste processing within the clinker production is an indirect recycling generating the valuable product cement without any significant negative influence of the product quality and its properties.
- The substitution of primary fuels like gas, coal or oil in the cement production saves those precious natural reserves for the future and reduces the import expenditures and the dependency on fossil fuels.
- **Concluding all the above facts, the utilization of waste derived materials in the cement production contributes to a huge benefit for the society, the ecology and the economy. It is the classical example for a successful combination of sociological, ecological and economical requirements.**

JK Cement India initial AFR information

- Initially used:

  Mustard husk (3200 kcal7kg), 1000 t per month (seasonally), 2000 INR/t
  Fibre mass (Textile industry) (6500 kcal/kg), 100 t per month, 3000 INR/t
  ETP sludge (Pharmaceutical industry) (4200 kcal/kg), 500 tpy, disposal fee. Disposal fee1068 INR/t.
  ETP sludge (Textile industry) (800 kcal/kg), 200 t per month, disposal fee 250 INR/t
  Solid mixed waste (mixture of industrial waste), (4200 kcal/kg), 2000 t per month,
  Liquid waste (chemical and pharma industry), (3500 kcal/kg), 1000 m3 per month, under negotiation.

- All AFR in Mangrol. Line I & II equipped with feeding hopper.
- ETP sludge of pharma industry also used in Muddapur. Manually through pocking hole into calciner.

THANK YOU VERY MUCH FOR YOUR KIND ATTENTION