



Analytical determination of recycling quota through SRF co-processing in the cement industry

Sandra A. Viczek, Alexia Aldrian, Roland Pomberger, Renato Sarc

Chair of Waste Processing Technology and Waste Management, Montanuniversitaet Leoben, Austria

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Content

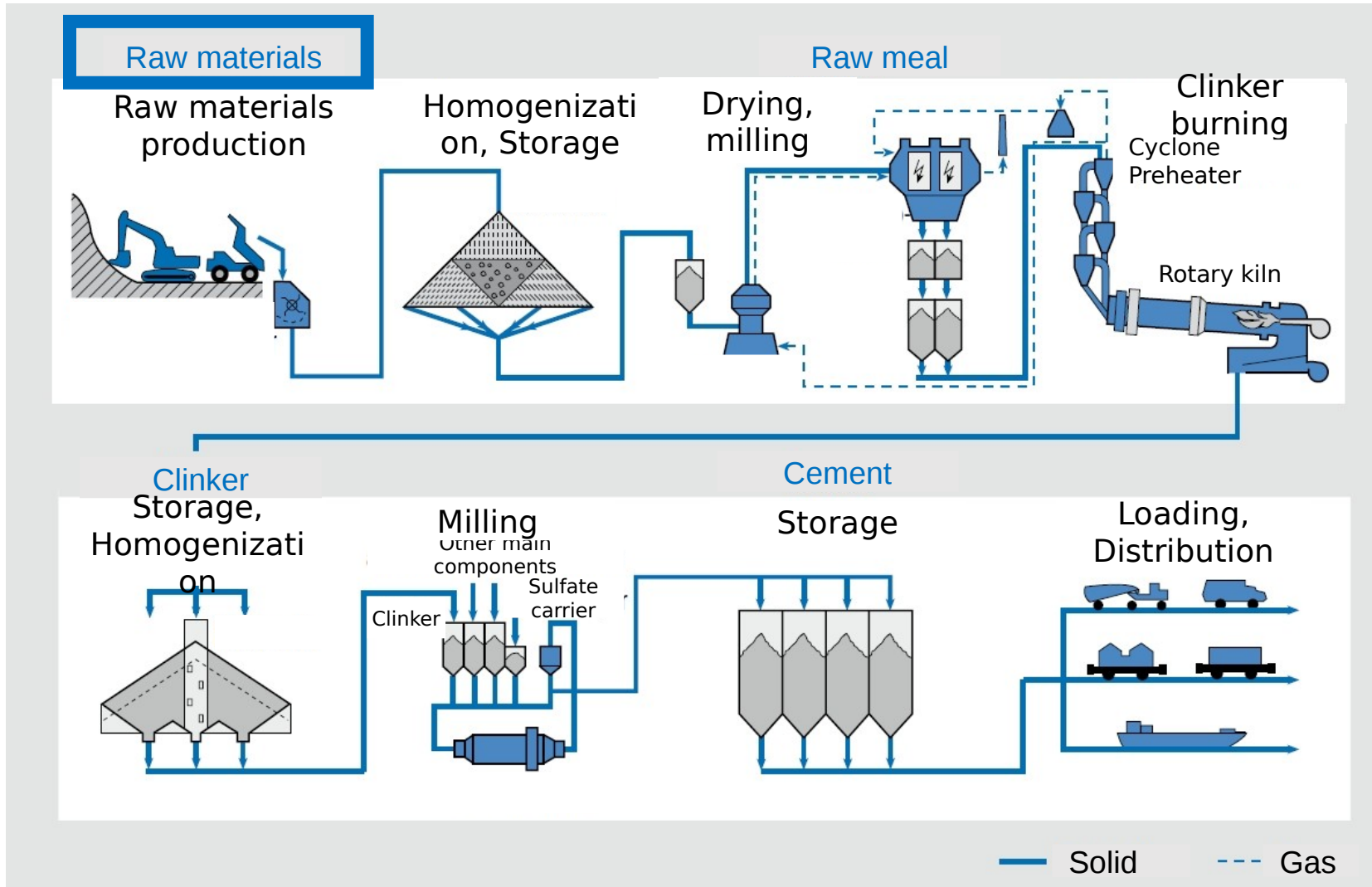
- Definition: Solid recovered fuels
- Cement manufacturing process
- Co-processing
- Aim
- Preliminary method
- First results
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Solid recovered fuels (SRF)

- Subgroup of refuse derived fuels (RDF)
- Produced from mixed or separated solid, non-hazardous wastes, including MSW
- Quality assurance required (EN 15359)
- Austria: additional limit values defined in waste incineration ordinance (As, Sb, Hg, Cd, Co, Pb, Ni, Cr)
- Used or “co-processed” in cement factories (Lower heating value (LHV) > 12 MJ/kg_{os})

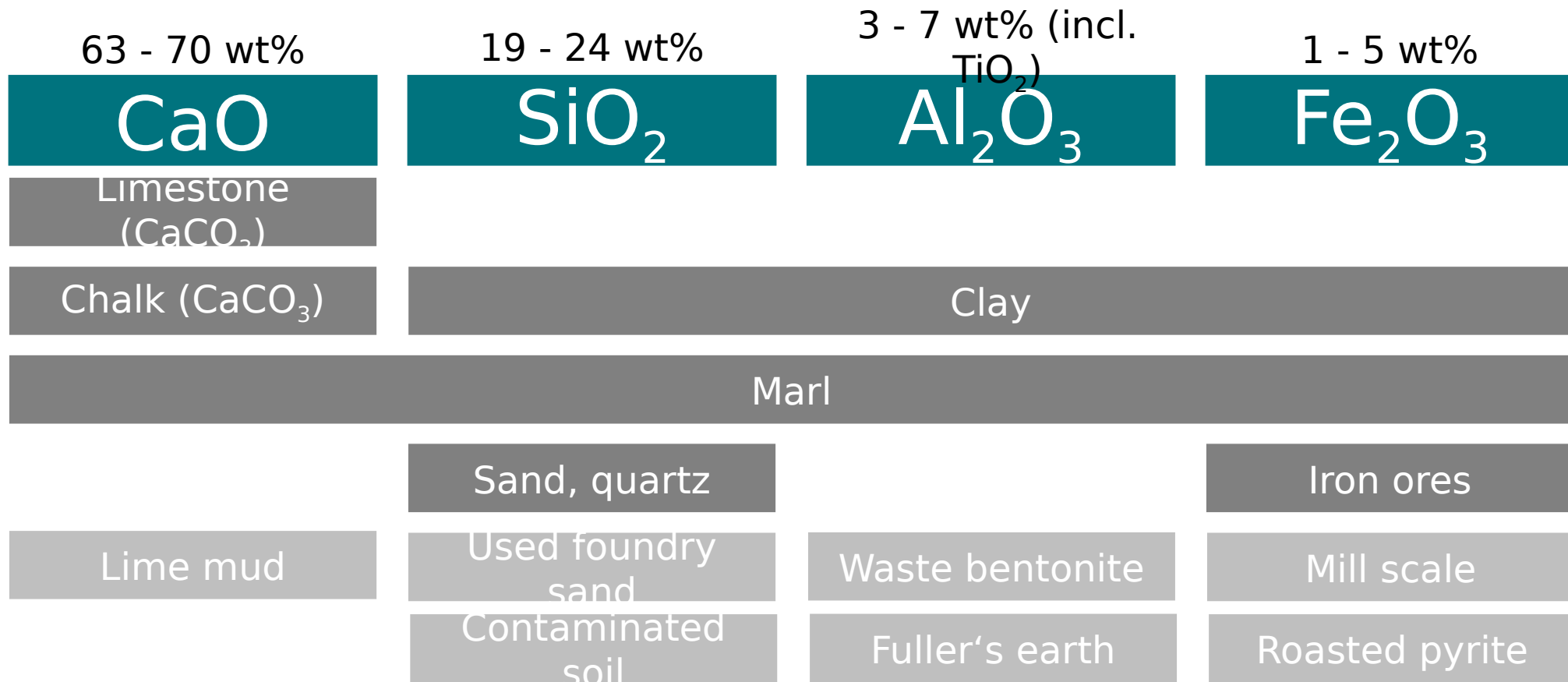


Cement manufacturing

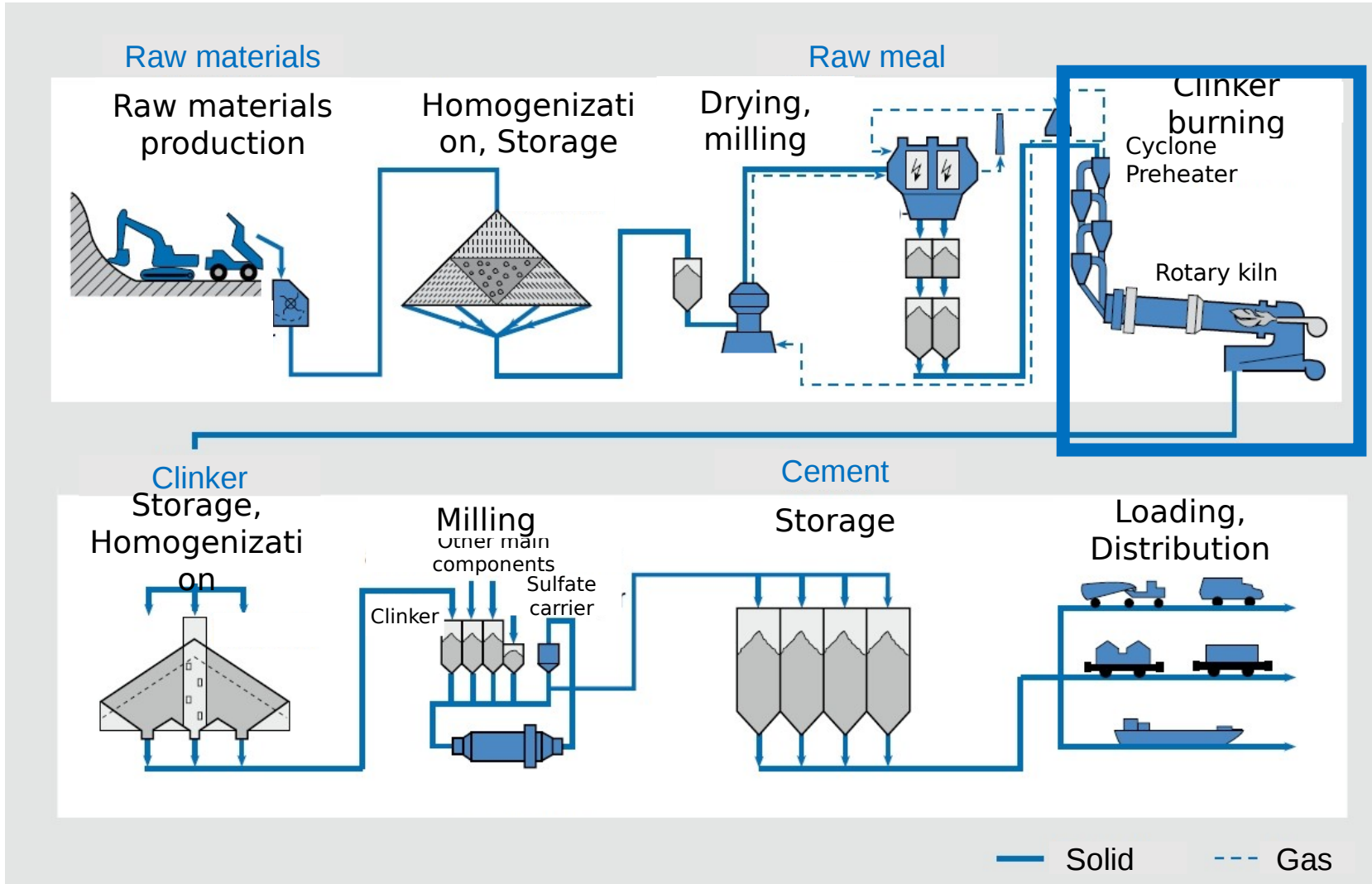


Raw materials for cement manufacturing

- Raw materials used for the production of cement clinker need to provide the **four main chemical compounds** required for the process:



Cement manufacturing



- Energy intensive
 - Austria 2017: 3.8 GJ per metric ton clinker
 - Germany 2017: 2.8 GJ/t clinker
- Substitution of fossil fuels with refuse derived fuels (RDF)
 - Austria 2017: > 80 % of thermal energy demand was covered by RDF
 - Germany 2017: 65 %
 - Type of fuel needs to be accounted for

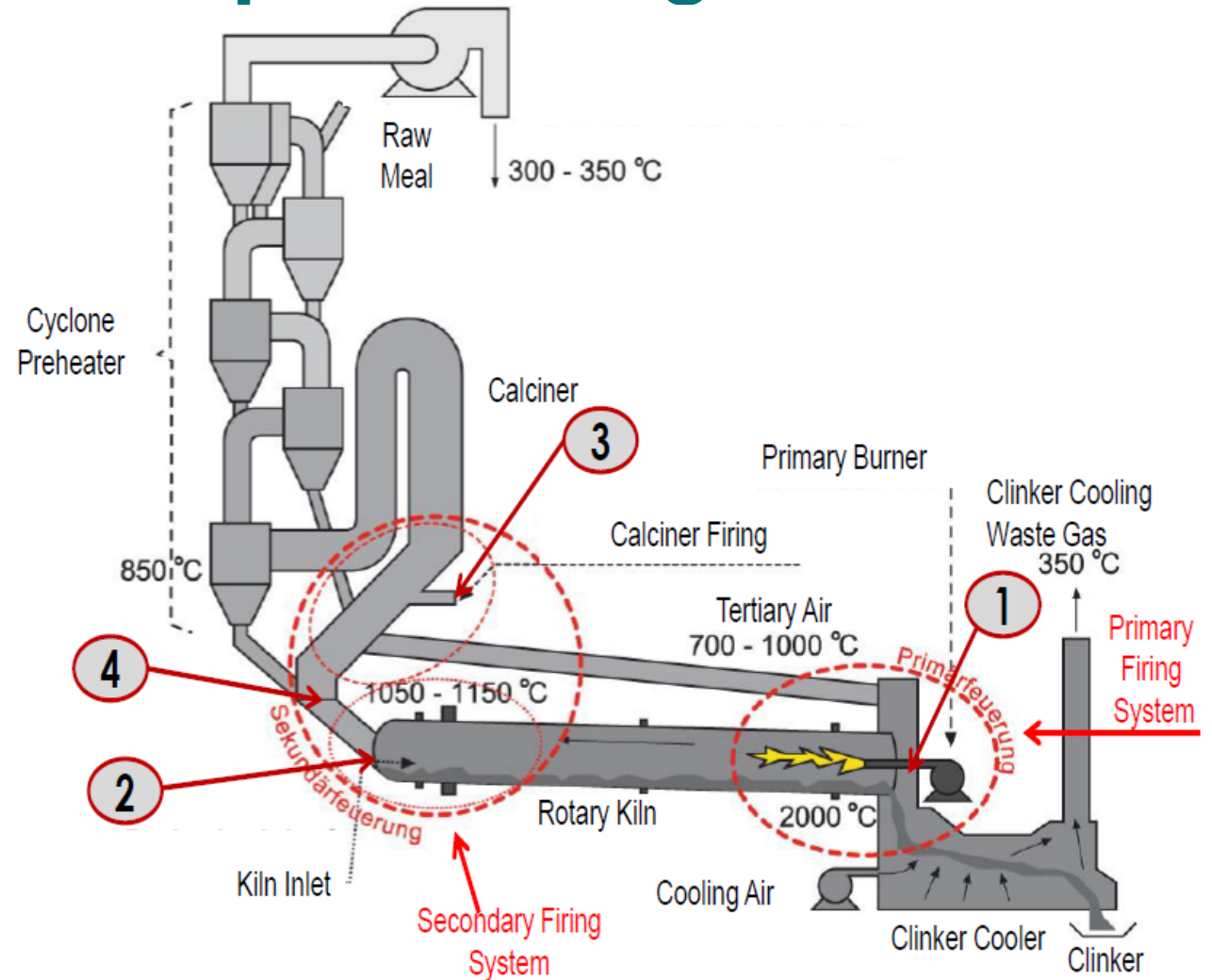
Co-incineration/co-processing

Co-processing comprises industrial processes that simultaneously

- enable energy recovery and
- recycling of the mineral content of waste material

thereby **substituting both fossil fuels and mineral resources**

Source: Basel convention Technical guidelines 2012, Lamas 2013.



Source: Sarc 2018.

Co-processing (II)

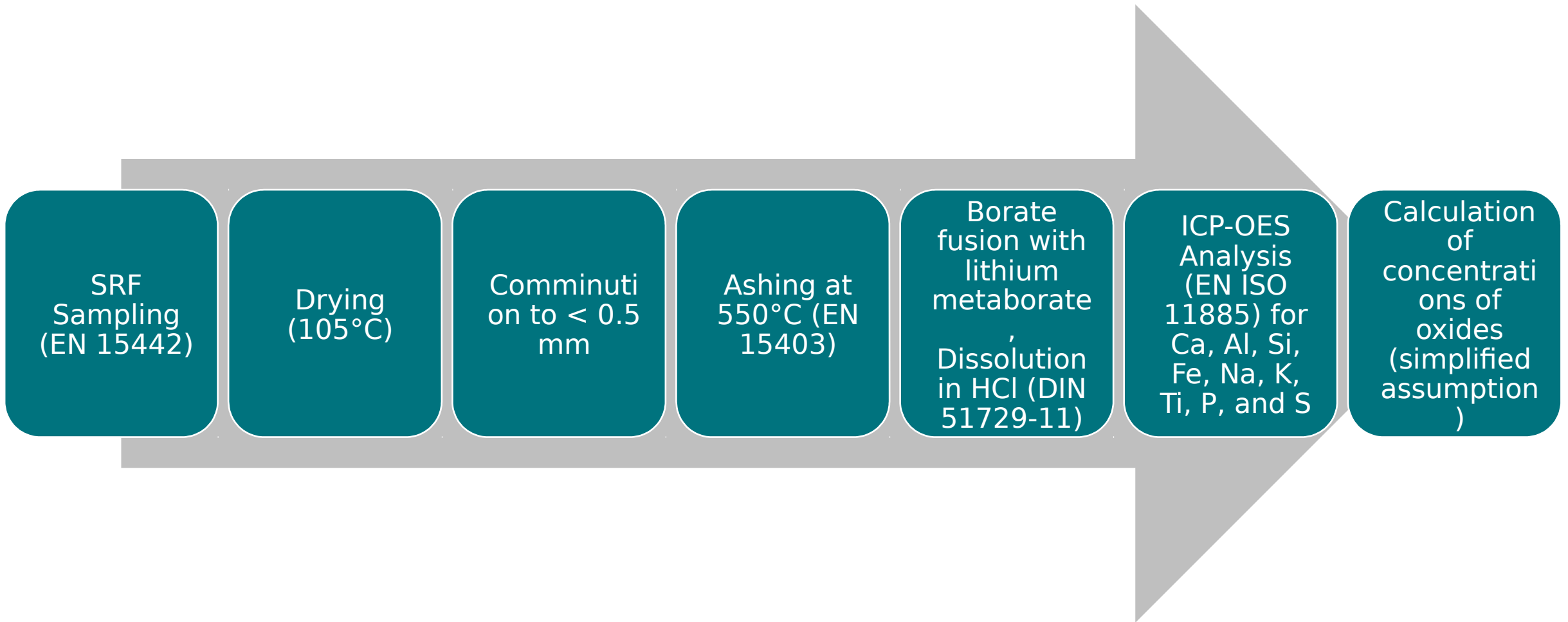
- In the waste hierarchy, the use of SRF as substitute fuels in the cement industry is currently considered as thermal or energy recovery
- Directive 2018/851 of the European Parliament and the Council, May 2018:
 - Amending directive 2008/98/EC on waste, i.e. the Waste Framework Directive
 - a paragraph was added stating that it is considered to acknowledge that certain minerals are incorporated in co-processing, and to count the share of these minerals towards recycling targets:

“The Commission shall assess co-processing technology that allows the incorporation of minerals in the co-incineration process of municipal waste. Where a reliable methodology can be found, as part of this review, the Commission shall consider whether such minerals may be counted towards recycling targets.”

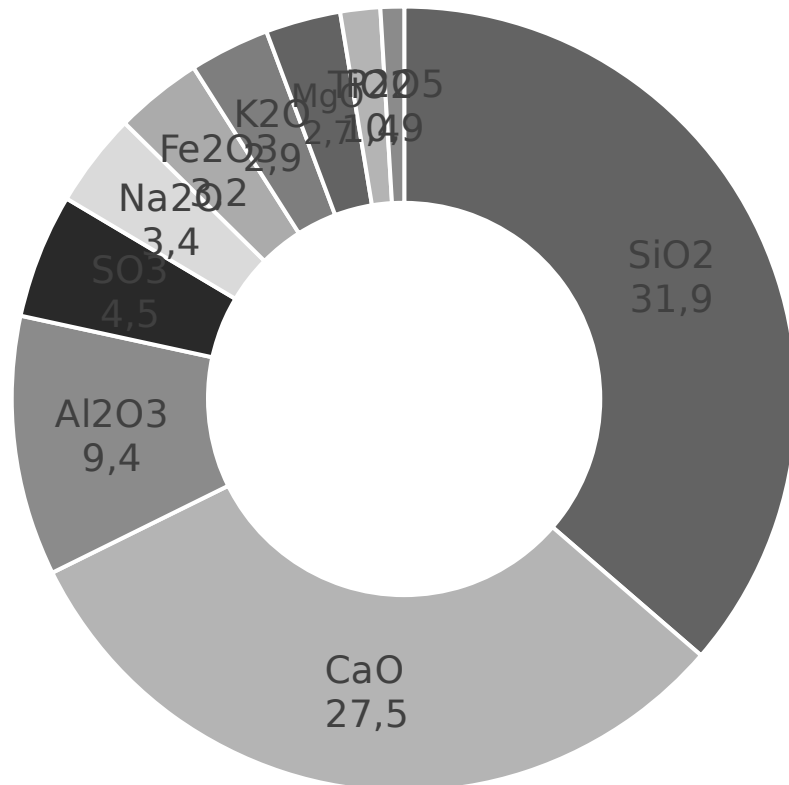
Aim of the research

- Developing a simple, but acknowledged and scientifically proven methodology for the analytical determination of both ash composition and the share of SRF that is material-recyclable
- Building up a database with ash compositions and material-recyclable shares of a large variety of SRF samples

Preliminary analytical method

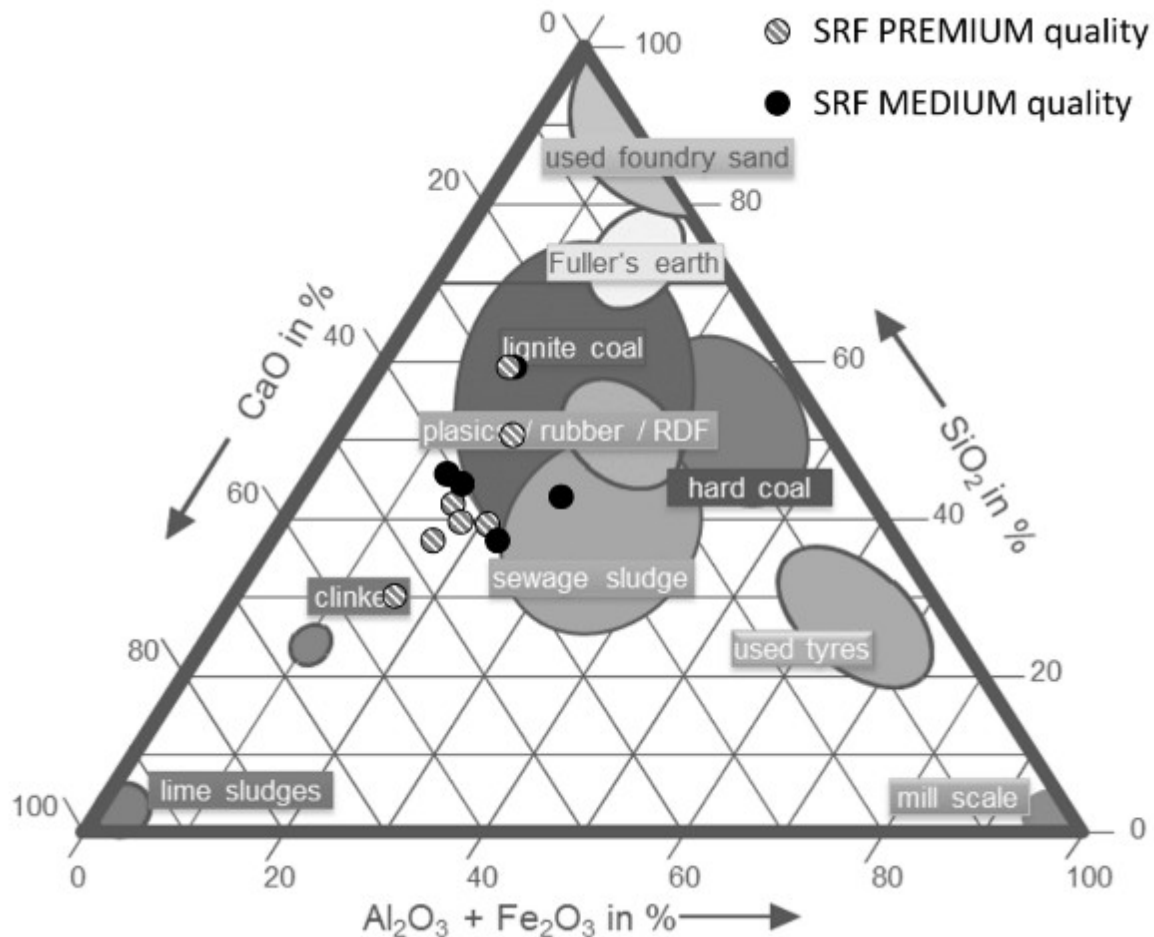


Preliminary results: SRF ash composition



- **72 ± 6 wt%_{DM}** of the SRF ash consists of **SiO₂, CaO, Al₂O₃, and Fe₂O₃**, the 4 main chemical components for cement production
- Other components present in the ash are also present in natural raw materials, fossil fuels, or clinker phases (K₂O, Na₂O, SO₃, MgO, TiO₂)
- Average ash content of SRF (550°C): **20 ± 6 wt%_{DM}**
- BUT: All components only sum up to 88 % of the ashes mass

SRF ash composition – comparison with raw materials and other fuel ashes



- Ratio of parameters of SRF ash similar to lignite coal ash
- Larger ratio of CaO, shifting SRF ash closer to the composition of clinker

Ternary diagram ©vdz supplemented with own results for SRF samples

Conclusions

- Method needs further improvement
 - Temperatures need to be varied (increased) and compared
 - Carbon content (TC, TOC, TIC) needs to be analyzed at different ashing temperatures
- Major part of the SRF ash is composed of the 4 main chemical components for the production of cement clinker
- This part of the SRF ash can therefore substitute raw materials
- The role of minor components needs to be discussed and evaluated

Contact

Sandra A. Viczek, MSc MSc

Tel.: +43 (0) 3842 / 402 - 5136

Mobile: +43 (0) 680 / 110 87 87

Fax: +43 (0) 3842 / 402 - 5102

E-Mail: sandra.viczek@unileoben.ac.at

MONTANUNIVERSITÄT LEOBEN

Chair of waste processing technology and waste management

Franz-Josef-Straße 18

8700 Leoben, Austria

<http://avaw.unileoben.ac.at>



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