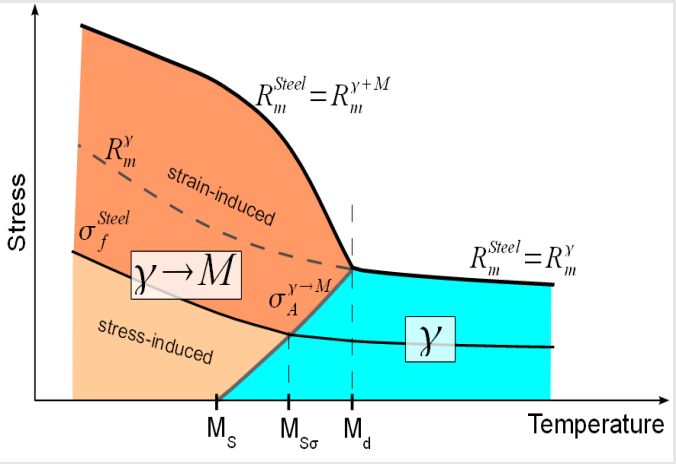
TECHNISCHE UNIVERSITÄT
BERGAKADEMIE FREIBERG
Die Ressourcenuniversität. Seit 1765.

Circular Economy and Raw Material Competence for Sustainable Production (CE-COSP)

Resource Efficient and Circular Ulitization of Primary and Secondary Raw Materials



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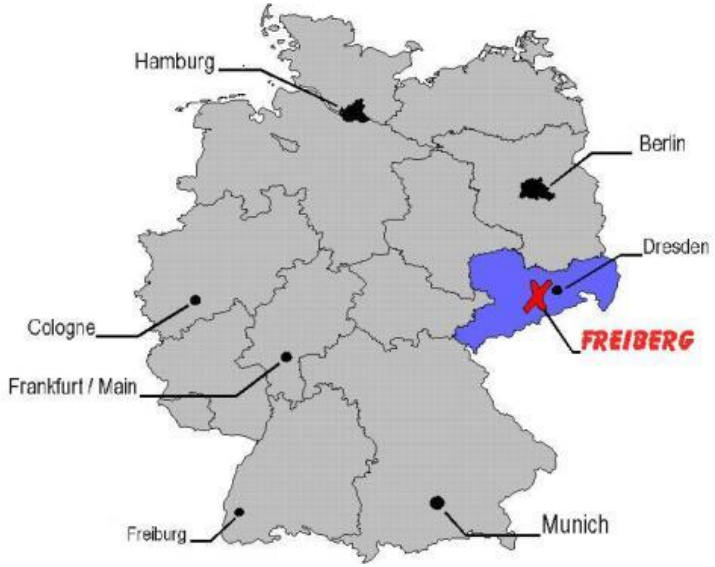
TU Bergakademie Freiberg

- World's oldest mining university (founded in 1765)
- 4.629 students, 6 faculties, 89 professors
- Focused on sustainable material and energy economy in research and education
- Core fields: Geo, Material, Energy and Environment



Source: http://tu-freiberg.de/en/university

Institute of Iron- and Steelmaking

- 32 members
- 12 doctorants
- 10 people from the government

- In 2017 – 1.200.000 euro - income from the projects

Source: http://tu-freiberg.de/en/university

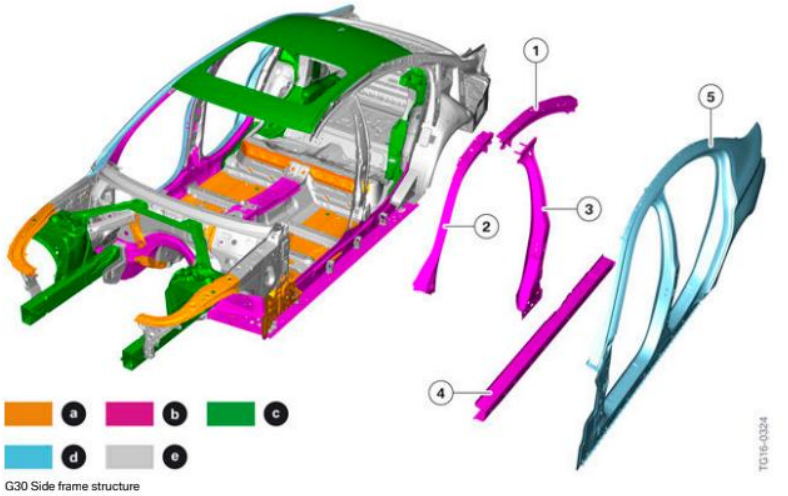
The course structure:

- Focus on: Resource Efficient and Circular Ulitization of Primary and Secondary Raw Materials from Automotive Industry

- The course consists of: lectures, practical applications (videos), seminars, field trips

Lectures

1. **Automotive**: components, materials, non-ferrous materials, plastics, glass, steels, chemical compositions and mechanical properties of steels, comparison of used steels today and 20 years ago (90min, Dr. Wendler, Dipl.-Ing. Perminov)



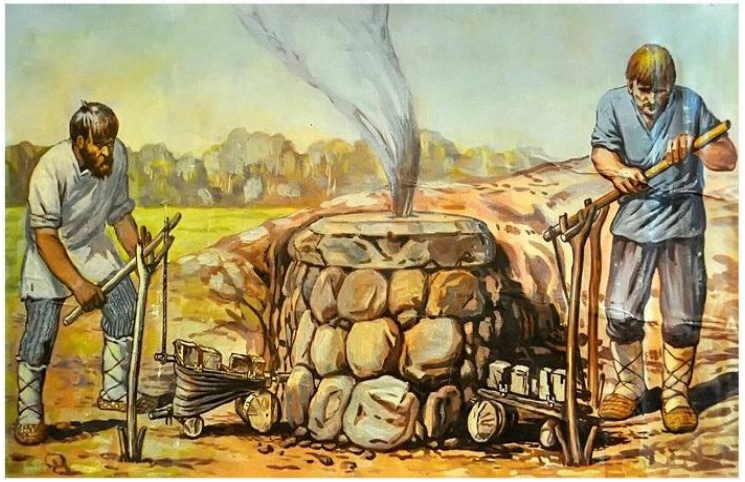
G30 Side frame structure

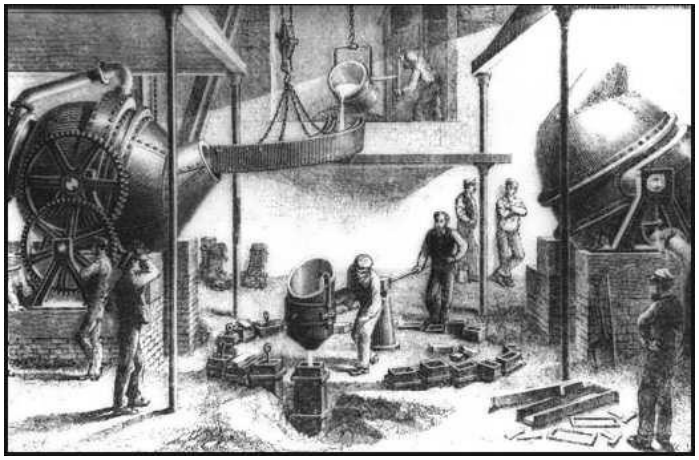
Index	Explanation
a	Multiphase steel (> 300 N/mm²)
b	Ultra-high-strength steel (> 900 N/mm²)
c	Aluminum
d	Deep-drawing steel (< 300 N/mm²)
e	Other steel grades
1	Inner roof frame
2	Roof frame reinforcement
3	B-pillar reinforcement
4	Side sill reinforcement plate
5	Outer side frame (deep-drawing steel)

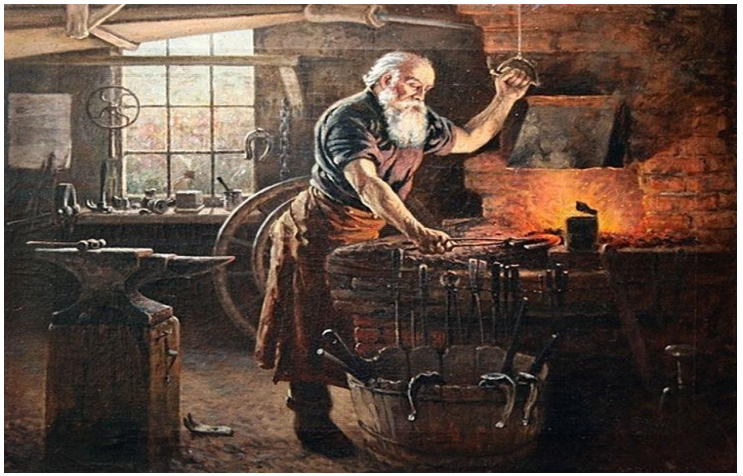
Source: BMW Group University Technical Training, 2016

Lectures

2. **History of Iron- and Steelmaking**: from the Iron Age to Electric Arc Furnaces, Bessemer Process and Modern Steelmaking, Open Heart process, oxygen steelmaking (90min, Dr. Wendler, Dipl.-Ing. Perminov)



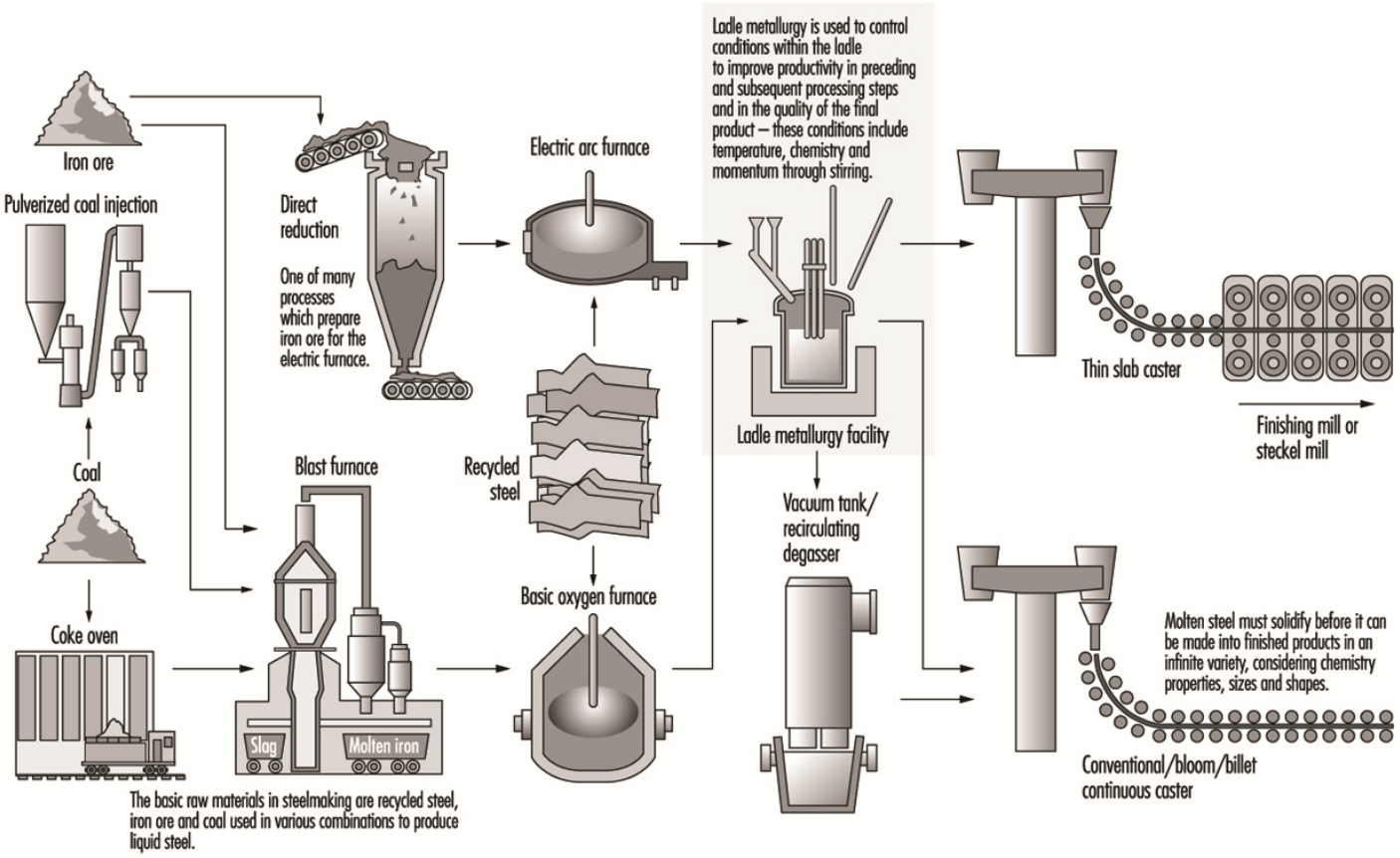




Source: Machines and Mechanisms Journal 2013

Lectures

3. **Steelmaking**: iron ore, blast furnace, direct reduction process (short, up to max 30 min). Two steelmaking routes: converter and electric furnace; Comparison of used materials and production qualities; special features and history (90min, Prof. Volkova, Dipl.-Ing. Perminov)



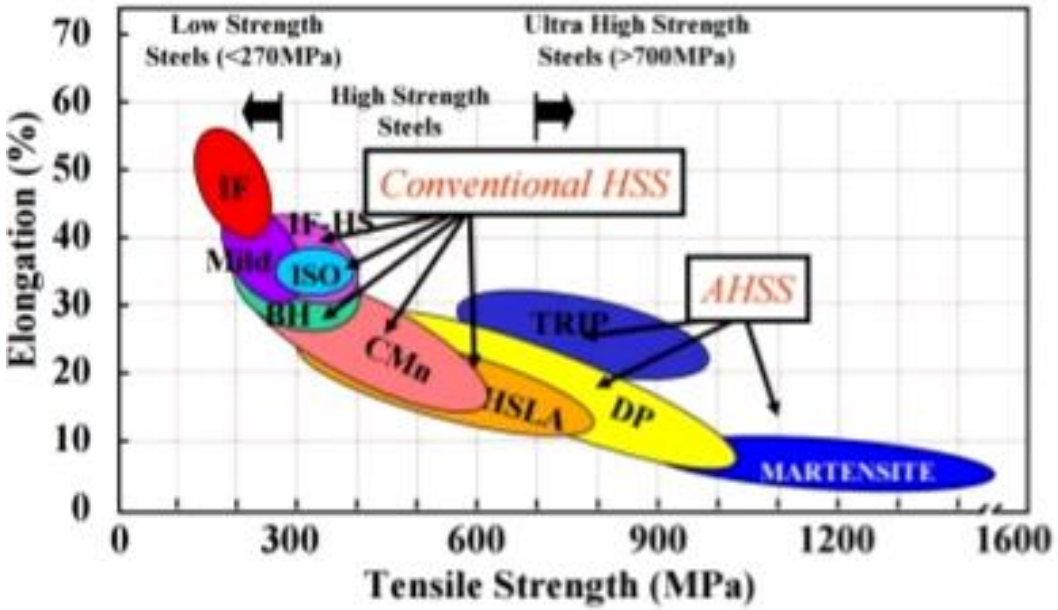
Lectures

4. **Steel scrap**: grades, processes for sorting and preparation of steel scrap, mechanical processes: baling, briquetting, shearing, schredding; magnetic separation, Eddy current separation, heavy media separation, separation by physical and chemical characteristics, decoating, dezincing, detinning, decopperization, incineration (90min, Dr. Kreschel, Dipl.-Ing. Bartzsch)

Source: https://www.kohl-recycling.de/en/scrap-trade/performance-spectrum/

Lectures

5. **Production of two different qualitites of automotive steels in the converter**: IF-steel, Trafo-steel. Special features of chemical analyzes, possible chemical analysis of crude steel, selection of scrap, slag control, phosphorus distribution (90min, Prof. Volkova, Dr. Heller, Dipl.-Ing. Bartzsch)



S. P. Bhat and A. P. Applications, "Advances in High Strength Steels," *East.*

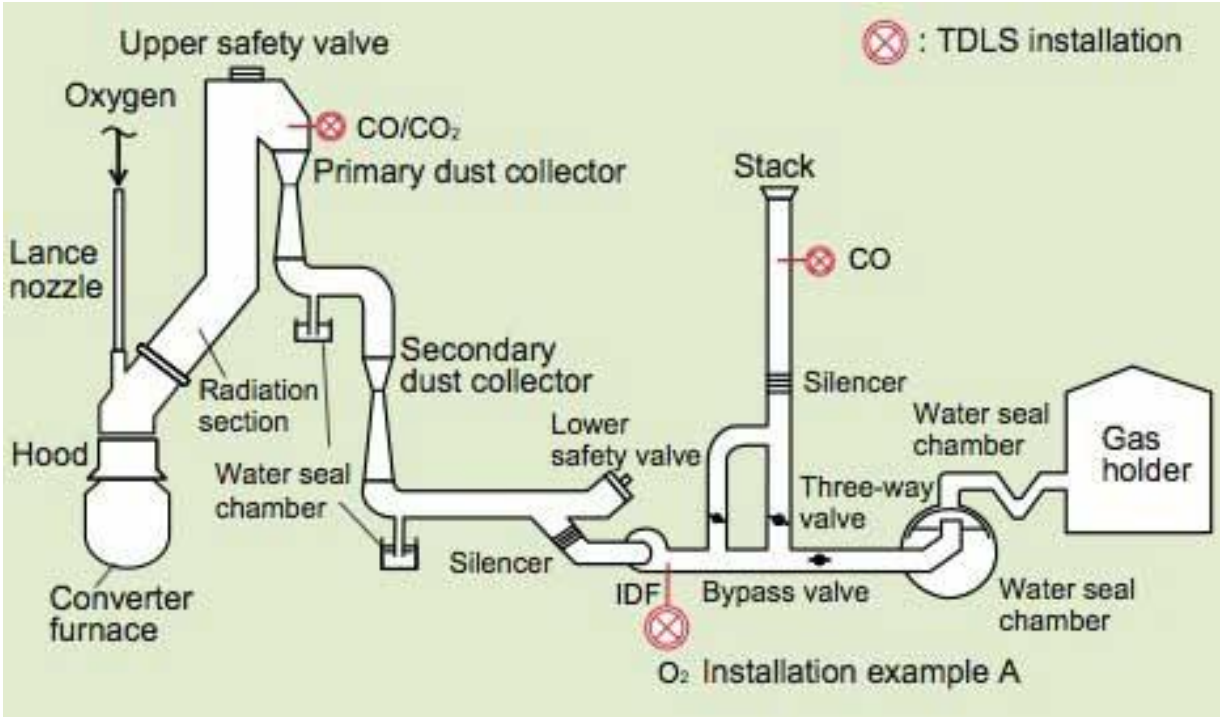
Lectures

6. **Converter slag:** components of slag, slag formation, tasks, processing, recycling, landfill, extraction of valuable elements from slag (90min, Dr. Heller, Dr. Fan, Dipl.-Ing. Shyrokykh)

Source: http://spynet.ru/blog/pics/14528.html

Lectures

7. **Converter dust and converter gas**: analyzes, possible application, cleaning, thermal use (90min, Dr. Heller, Dr. Fan, Dipl.-Ing. Shyrokykh)



Source: Yokogawa (2011). Measurement of O2 Concentrations in Recovery Flue Gas from Converter Furnace by the TDLS200

Lectures

7. **Tramp elements in converter**: copper, tin, sources, possibilities of removal (90min, Prof. Volkova, Dipl.-Ing. Sandig)

Practical applications in metallurgy (videos)

1. **Refining of a molten steel.** (15min-20min, Dr. Heller, Dipl.-Ing. Perminov)
2. **Oxygen measurement.** (15min-20min, Dr. Heller, Dipl.-Ing. Perminov)
3. **Temperature measurement**. (15min-20min, Dr. Heller, Dipl.-Ing. Bartzsch)
4. **Chemical analysis of steel and slag samples.** (15min-20min, Dr. Kreschel, Dipl.-Ing. Shyrokykh)

Seminars

1. **Calculation of converter charge.** (90min, Dr. Heller, Dipl.-Ing. Bartzsch)

2. **Cost calculation of a converter heat with differnt types of scrap.** (90min, Prof. Volkova, Dipl.-Ing. Shyrokykh)

3. **Cost calculation of a converter heat when using different slag carries.** (90min, Prof. Volkova, Dipl.-Ing. Shyrokykh)