Sampling and preparation of heterogeneous waste fuels?

Is it possible to accomplish a representative and relevant composition data?

Evalena Wikström, Lennart Gustavsson and Jolanta Franke

SP Swedish National Testing and Research Institute

Aim of the project

To suggest a method for sampling and mass-reduction valid for heterogeneous waste fuels

Consisting of:

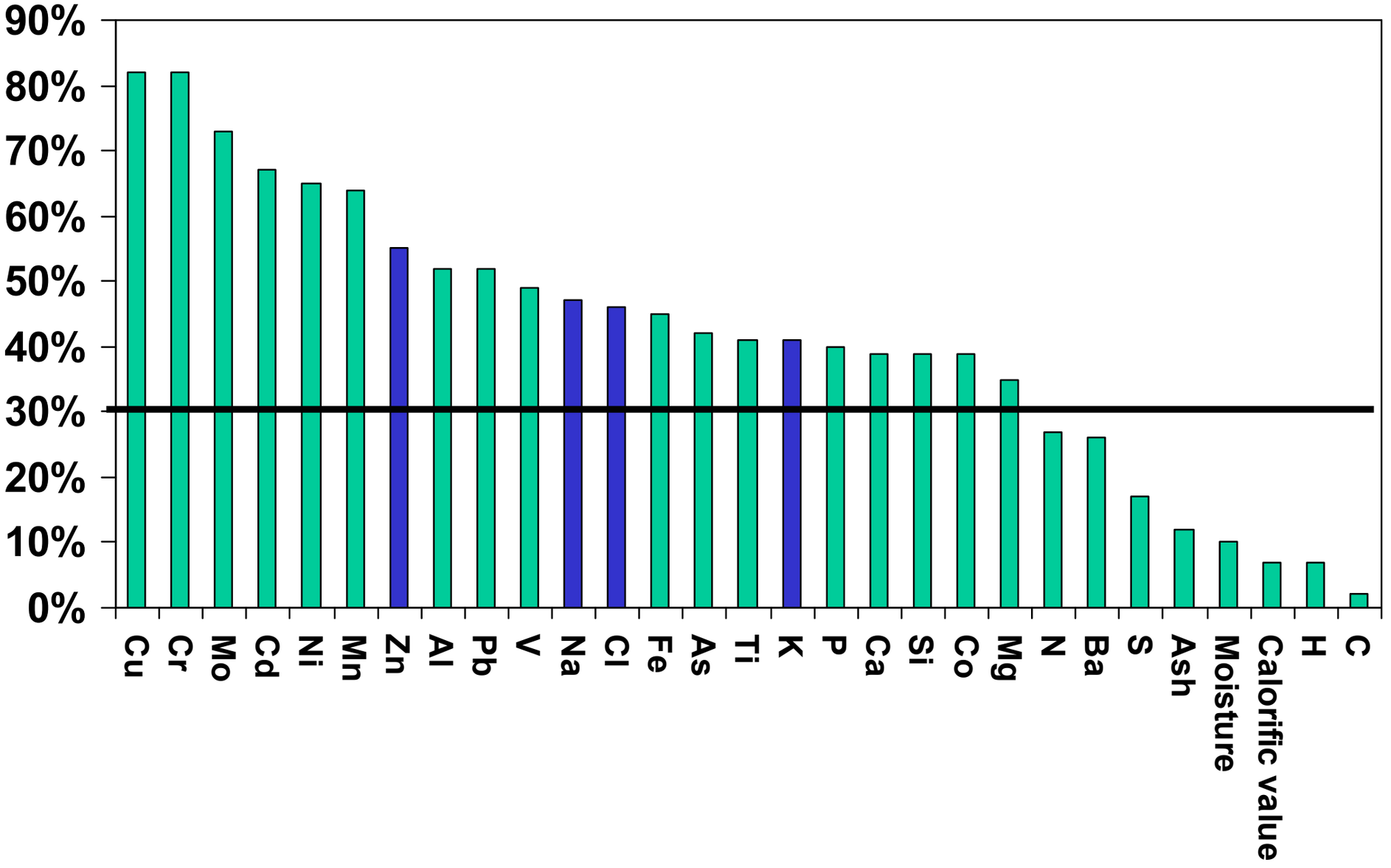
- ✓a minimal sample size that accomplish representative data
- ✓a mass-reduction technique at site
- ✓a routine for the first grinding step
- ✓a sample reduction method at the lab

Background

- Two new standards “ methods for sampling” and “laboratory preparation” for Solid Recovered Fuels (SRF) valid from ´06
- Heterogeneous waste fuels are about the most difficult to sample correct
- The composition varies a lot
- Correct fuel composition data has a large impact on the accessibility, emissions and maintenance cost of a boiler
- The future market of waste fuels will demand accurate composition data of a mixture

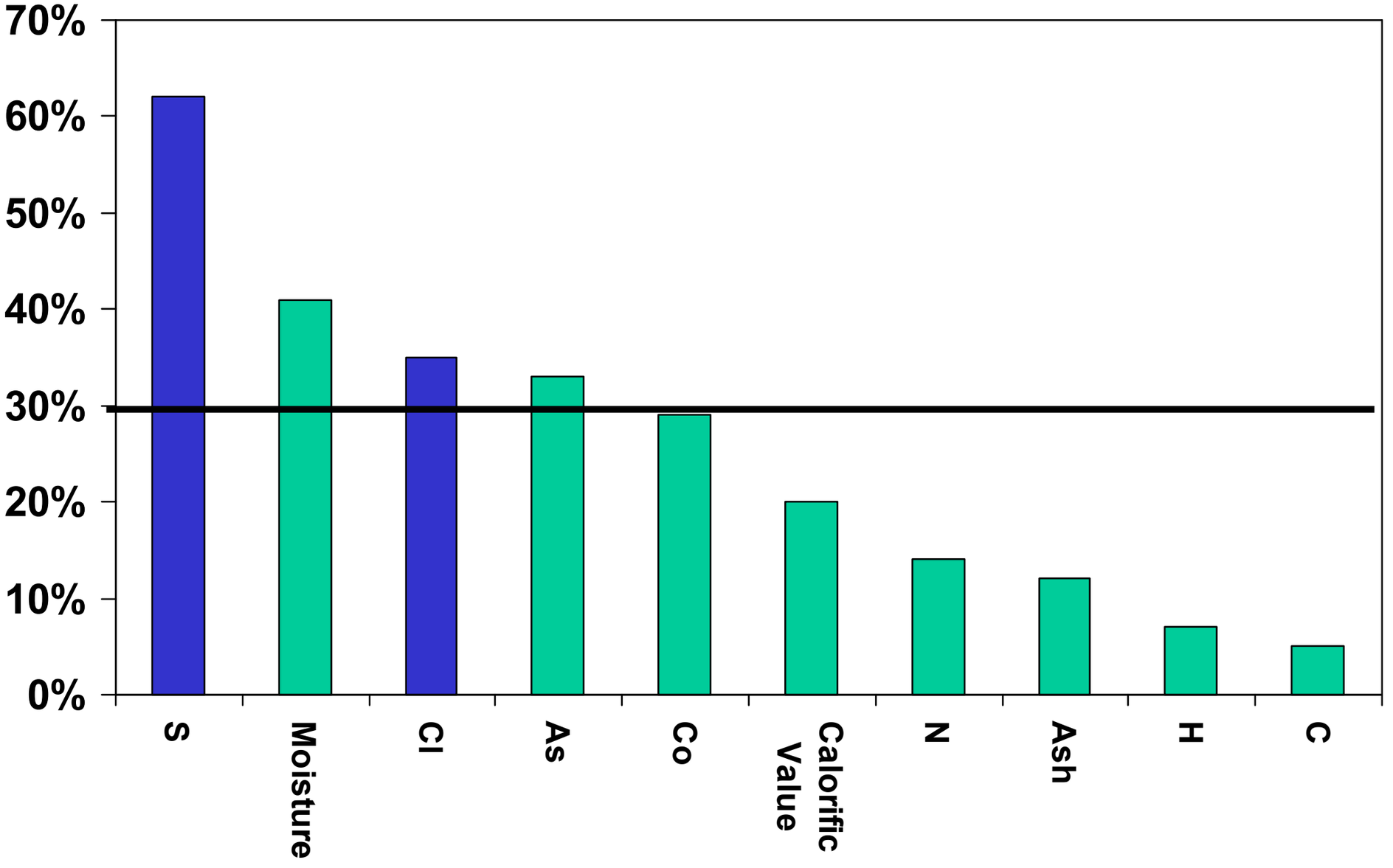
Example variation in data N=6

A 20 W Waste incinerator
Pre-treated, grinded waste

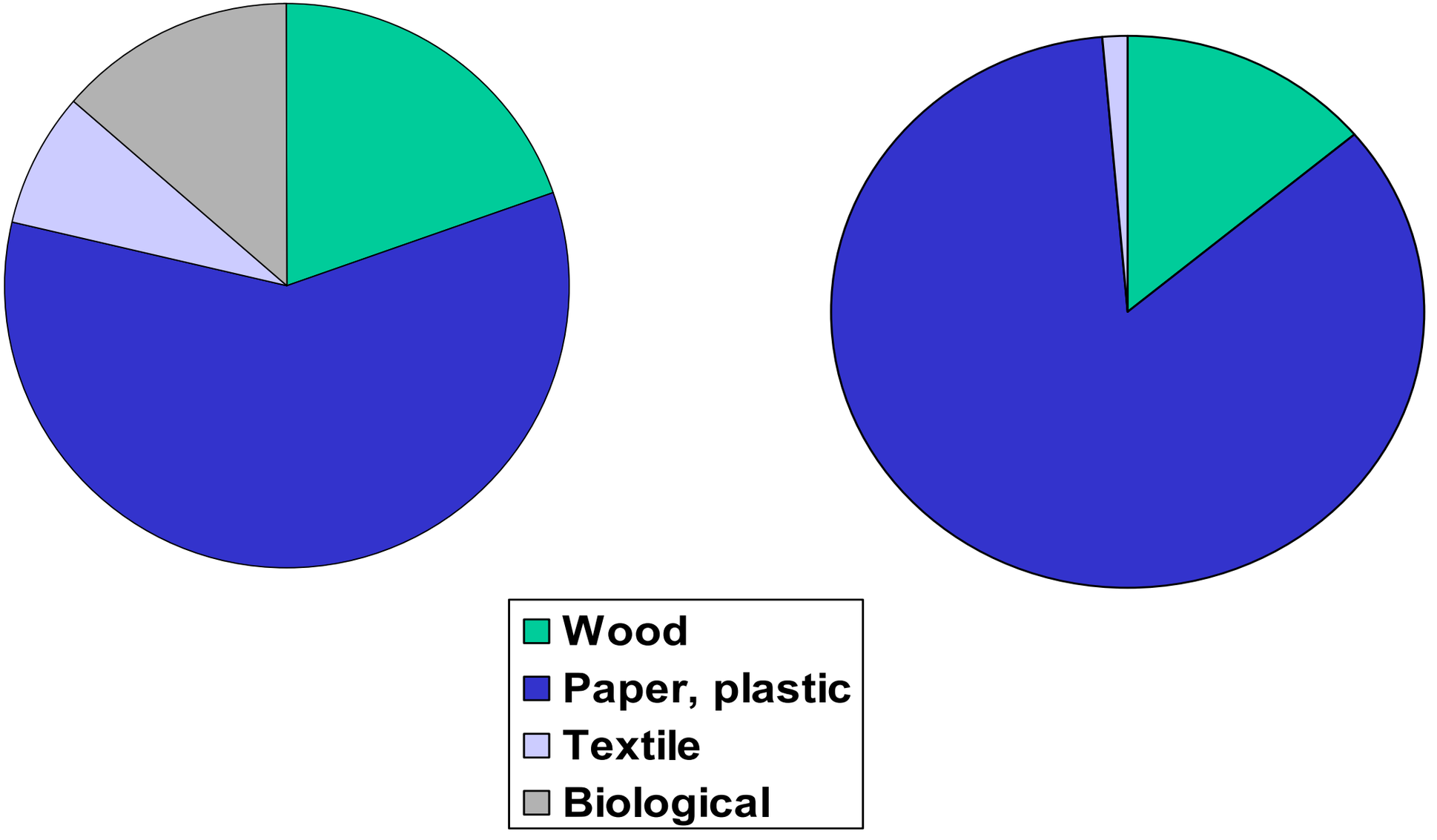


Example variation in data N=14

A 20 W Waste incinerator
Non-treated waste



Variation in sorting analyses



Element and risks

- Sampling
  - Method
  - Volume/mass
  - Duration time
- Sample reduction
  - Method
  - Volume/mass
- Preparation at the lab
  - Sample reduction
  - Size reduction
- Analyses
  - Method
  - Technique

Two new standards for Solid Recovered Fuels

Solid Recovered Fuels – Methods for sampling **CEN 15442** (Jan 2006)

Solid Recovered Fuels – Methods for laboratory sample preparation **CEN 15443** (Jan 2006)

What is required to work according to theses standards

Two new standards for Solid Recovered Fuels

Necessary elements for developing a sampling plan

1. Define overall objectives
2. Define lot and determine lot size
3. Define sampling procedures
4. Define minimum number of increments
5. Define minimum sample size
6. Define effective increments and sample size
7. Define methods for reducing the sample size
8. Define analytical methods

Quantity waste produced during a consecutive period

Size of each portion

Size of the total sample

Actual total sample size

Solid Recovered Fuels – Methods for sampling

Determination of minimum sample size

Input/information required:

- The nominal top size of a particle d_{95} = ?
- The maximum volume of a particle V_{95} = ?
- The shape factor $s=V_{95}/(d_{95})^3$ = ? or 1
- The particle density = 1
- The bulk density = ?
- The distribution factor = 0,25
- The factor *p* = 0,01
- The coefficient of variation *CV* = 0,01

=> minimum sample size

Solid Recovered Fuels – Methods for sampling

SP Swedish National Testing and Research Institute

Determination of minimum increment size

Mechanical sampling

- The nominal top size of a particle d_{95}
- Drop speed

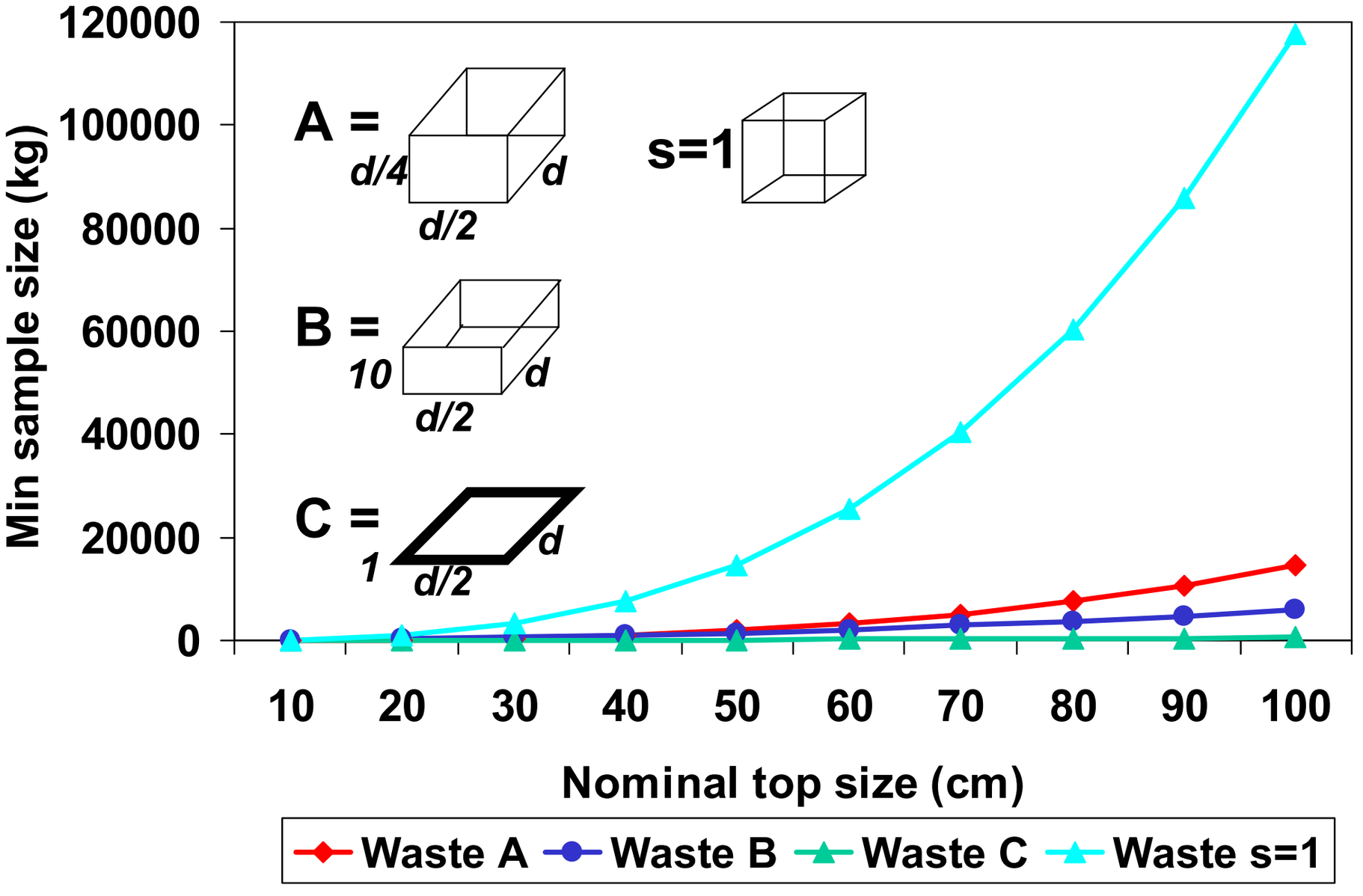
or

Manual sampling

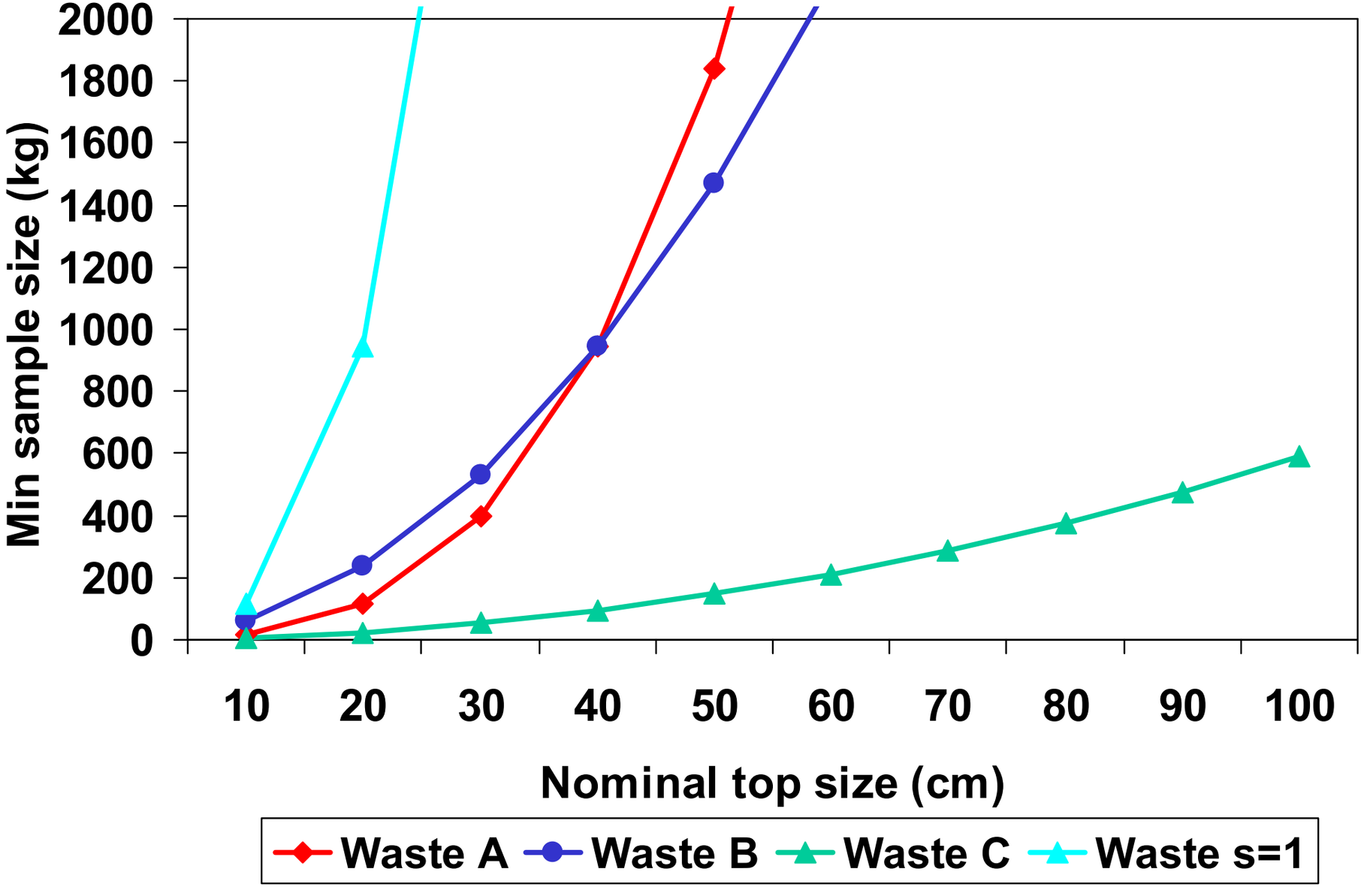
- Drop speed
- Sampling time

=> minimum increment size

Minimum sample size



Minimum sample size (reduced scale)



Solid Recovered Fuels – Methods for sampling

- Effective increment size=Min sample size / #increments

⇒ **Effective increment size > Min increment size**

- Effective sample size=Eff. Increment * #increments

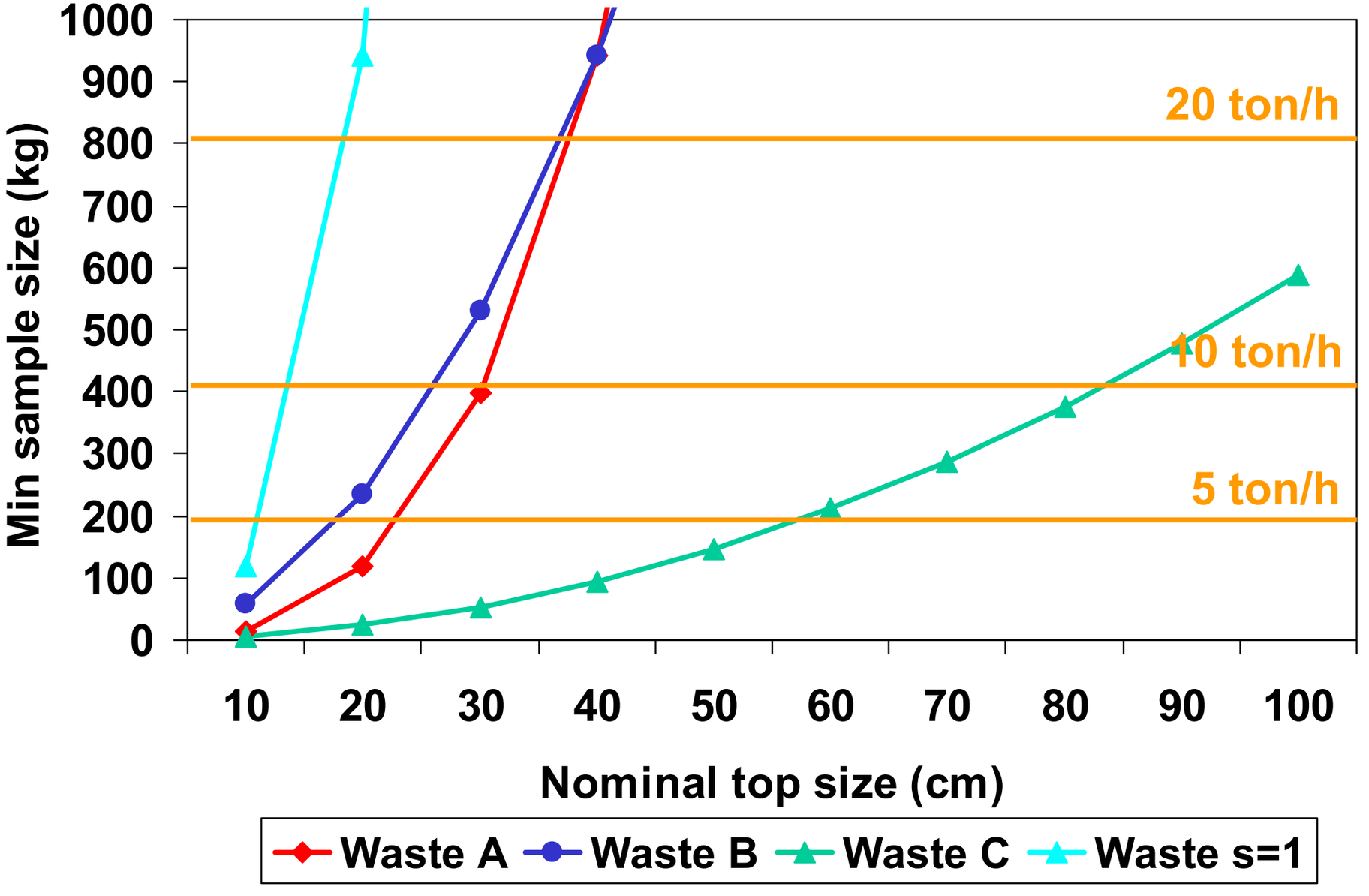
⇒ **Effective sample size > Min sample size**

#increments ≥ 24

Example:

When d95 is smaller than 30 cm the effective increment size and sample size is controlled by the waste flow to the incinerator.

Minimum sample size vs effective sample size



Sample reduction – reduce the size with unchanged sample composition

At the site: Coning, Strip mixing, Long pile, Manual increment division

At the lab: Riffle boxes, Rotary sample dividers, grinding

The **third-power law** controls the mass-reduction

Reduction factor d_{95}	Reduction factor of the sample size
2	8
5	125
10	1 000
30	27 000

Test plan of the project

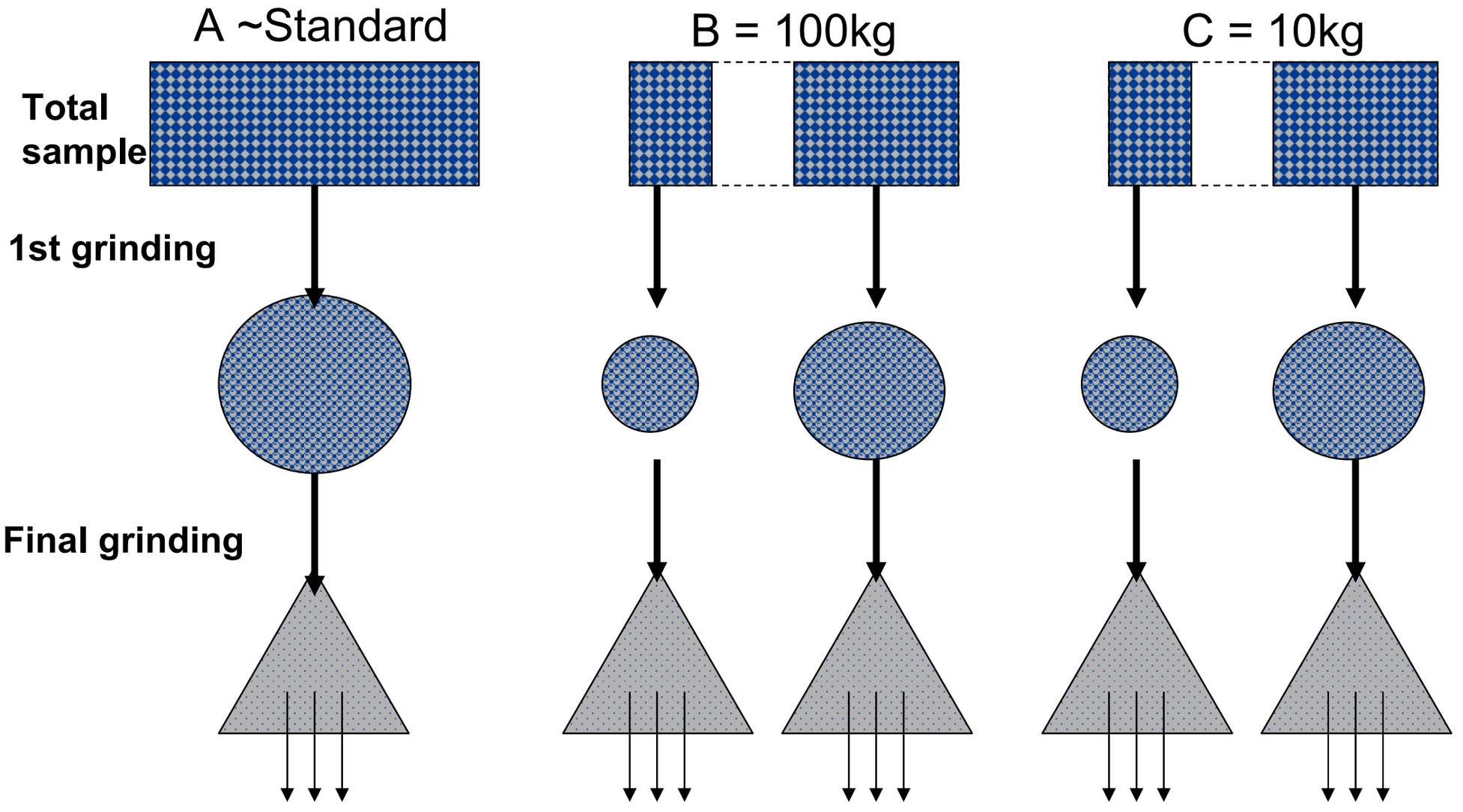
- **Overall objectives:** To determine the possibilities to simplify the sampling methods and still accomplish a representative sample from a MSW incineration plant with non-treated waste
- **Define the lot**: 24 hours
- **Sampling procedure:** Manual, drop flow
- **Minimum number of increments:** 24
- **Minimum sample size:** d_{95}=30 => 400 kg
- **Minimum increment size:** 37 kg *(based on 22 ton/h)*
- **Effective increment size:** 17 kg (400 kg/24)
- Effective increment size > minimum increment size
- **Effective sample size:** 880 kg (37*24)

Test plan

- Sample A ~ to standard
- Sample B = 100 kg
- Sample C = 10 kg
- Test of 25 and 50 % of the sample volume

- How well does sample B and C imitate sample A?
- What simplifications can be made without influence the quality?
- Which sample size is recommended?
- How much dose the initial preparation sample volume affects the quality of the data?

Test plan of the project



A simplified sampling and preparation method

- Suggest a minimal sample size that accomplish representative composition data
- Suggest a mass-reduction technique at site
- Suggest a routine for the first grinding step
- Suggest a sample reduction method at the lab
- Based on experimental data and the two standards

…all valid and suitable for heterogeneous waste fuels