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Pulp and Paper Industries' Engineering Co

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Recommendations for the design and sizing of pipe systems

Introduction

This document supersedes SSG 1630, Edition No. 2. The document gives recomendations for the design and sizing of pipe systems.

1 Engineering design

1.1 General

In designing pipelines, account must first of all be taken of the applicable physical laws. For instance, suction pipes for pumps must be made so large that cavitation is prevented. The required positive suction head for a certain pump is usually clear from the pump supplier's diagram and is given as NPSH. This is described in greater detail in Appendix No 1.

1.2 Methods

The following appendices to this standard give recommendations for the technically optimum sizes of pipe systems:

Appendix No 1	NPSH (Net Positive Suction Head)
Appendix No 2	Example of the design and sizing of pump installation for water as medium
Appendix No 3	Recommendations for the design and sizing of pipelines for pulp suspensions
Appendix No 4	Nomograms for calculation of pipe flow for Newtonian liquids and gases
Appendix No 5	Loss coefficients to be used in pipe flow calculations

2 Economic design

2.1 General

In designing pipelines, account must first of all be taken of the applicable physical laws. For instance, suction pipes for pumps must be made so large that cavitation is prevented. The required positive suction head for a certain pump is usually clear from the pump supplier's diagram and is given as NPSH. This is described in greater detail in Appendix No 1.

2.2 Pipeline cost

Pipeline cost can be divided into a fixed element Kf and an operational element Kd. By calculating these as set out below (Subsections 2.21 and 2.22) and adding the costs Kf and Kd for the different pipe sizes, the pipe diameter for the lowest total cost can be determined. This is then the sought optimum diameter. See also Fig. 1, p.. Fig. 3 on p. shows the calculated economic pipe diameters for pipelines usually employed in the forestry industry.
An example calculation for a pump plant is given in Appendix No 2.

2.21 Fixed cost (Kf)

The fixed cost Kf is the sum of the annual loan instalments including interest and the annual maintenance cost borne by the plant.

2.22 Operational cost (Kd)

The operational cost Kd is the actual cost of energy for transporting the medium concerned through the pipeline over one year. The operational cost Kd is calculated from the formula

[$$Kd = \frac{H \times Q \times \rho \times T \times e}{102 \times \eta_p \times \eta_m} \text{ SEK/year}$$]

H = total lift in m WG which is the sum of the static lift and the dynamic pressure drop through the pipeline

Q = rate of flow in m^3/sek

ρ = density in kg/m^3

T = working time in h/year

[e = price of electricity in SEK/kWh]

η_p = pump efficiency

η_m = motor efficiency

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