

# oe4625 Dredge Pumps and Slurry Transport



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October 13, 2004

1

# 9. PRODUCTION OF SOLIDS IN A PUMP-PIPELINE SYSTEM

## PRODUCTION RANGE

## PRODUCTION LIMITATION BY PIPE LENGTH

## PRODUCTION LIMITATION BY PUMP POSITION

# Flow Parameters: Production of Solids

The **production of solids** is an important parameter from the economic point of view. It gives the amount of dry solids delivered at the pipeline outlet over a certain time period.

This is defined as *the (volumetric) flow rate of solids* at the outlet of a slurry pipeline

$$Q_s = \frac{\pi}{4} D^2 V_m C_{vd} 3600 \left[ \frac{m^3}{hour} \right]$$

During a dredging operation the parameters  $V_m$  and  $C_{vd}$  are usually measured in a pipeline of known  $D$  so that the production of solids given by a solids flow rate can be determined.

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$$Q_s = Q_m C_{vd} = Q_m \frac{\rho_m - \rho_f}{\rho_s - \rho_f} \left[ \frac{m^3}{\text{sec}} \right]$$

During a dredging operation the parameters  $V_m$  and  $C_{vd}$  are usually measured in a pipeline of known  $D$  so that the production of solids given by a solids flow rate can be determined.

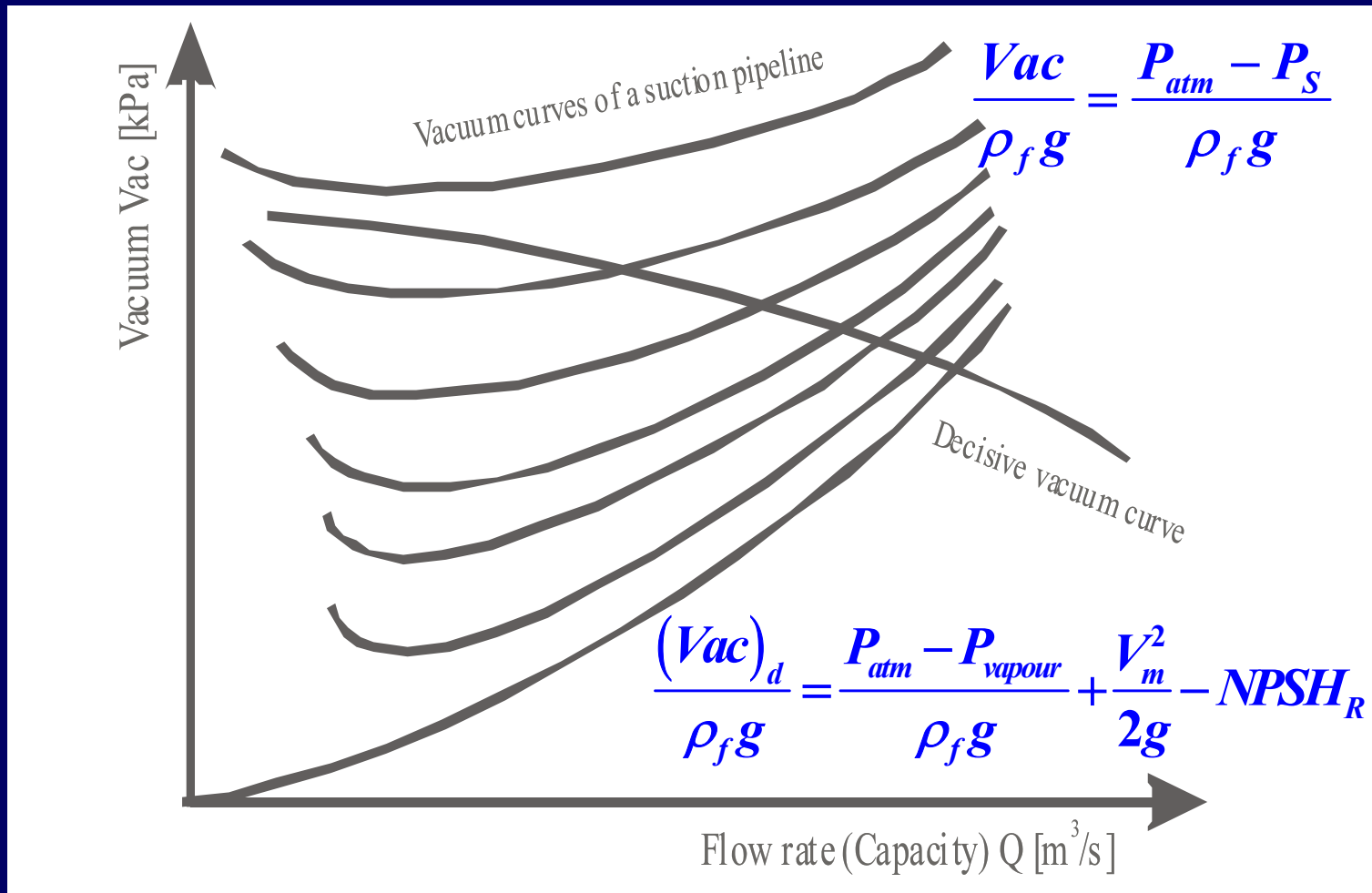
# PRODUCTION RANGE

## OPERATIONAL LIMITS

**MAXIMUM ATTAINABLE PRODUCTION**

**MINIMUM ACCEPTABLE PRODUCTION**

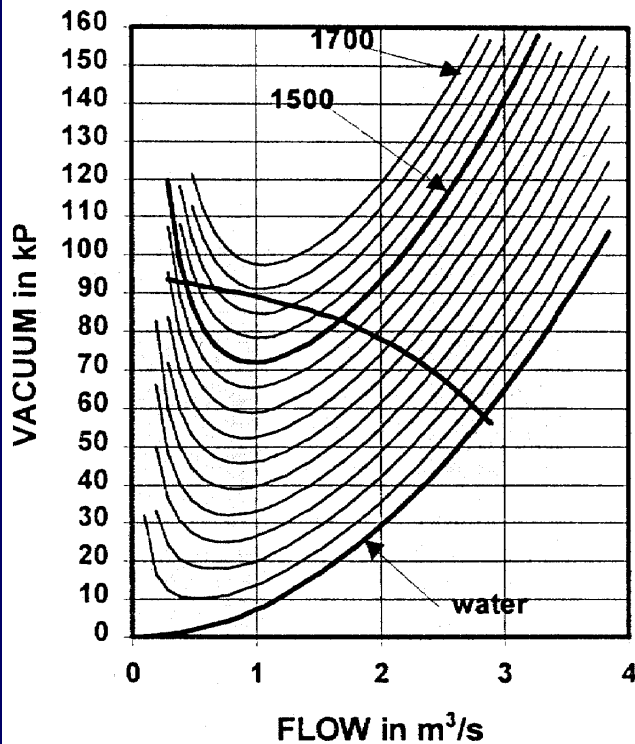
# MAXIMUM VELOCITY IN THE SYSTEM



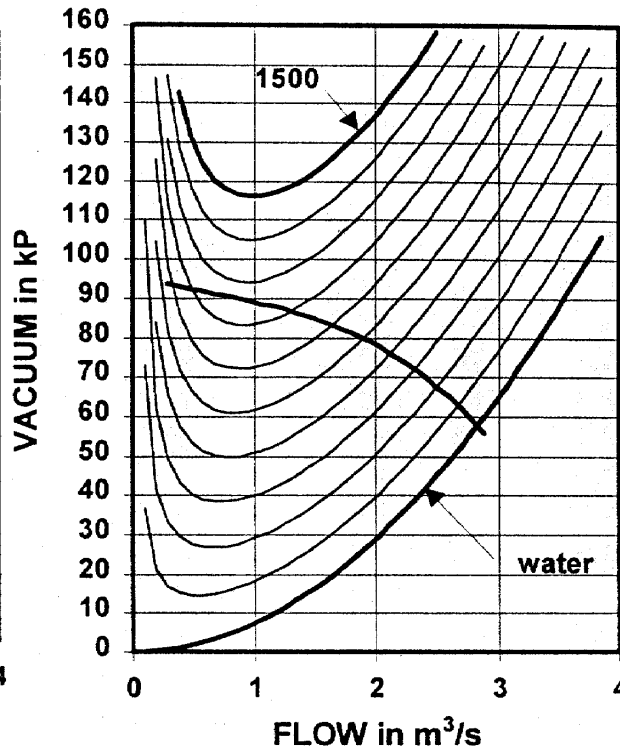
October 13, 2011 **Decisive vacuum curve,  $(Vac)_d$  & vacuum curves of suction pipe,  $Vac$ .**

# EFFECT OF PUMP POSITION ON OPERATIONAL LIMITS

Dredging depth 9 m



Dredging depth 18 m



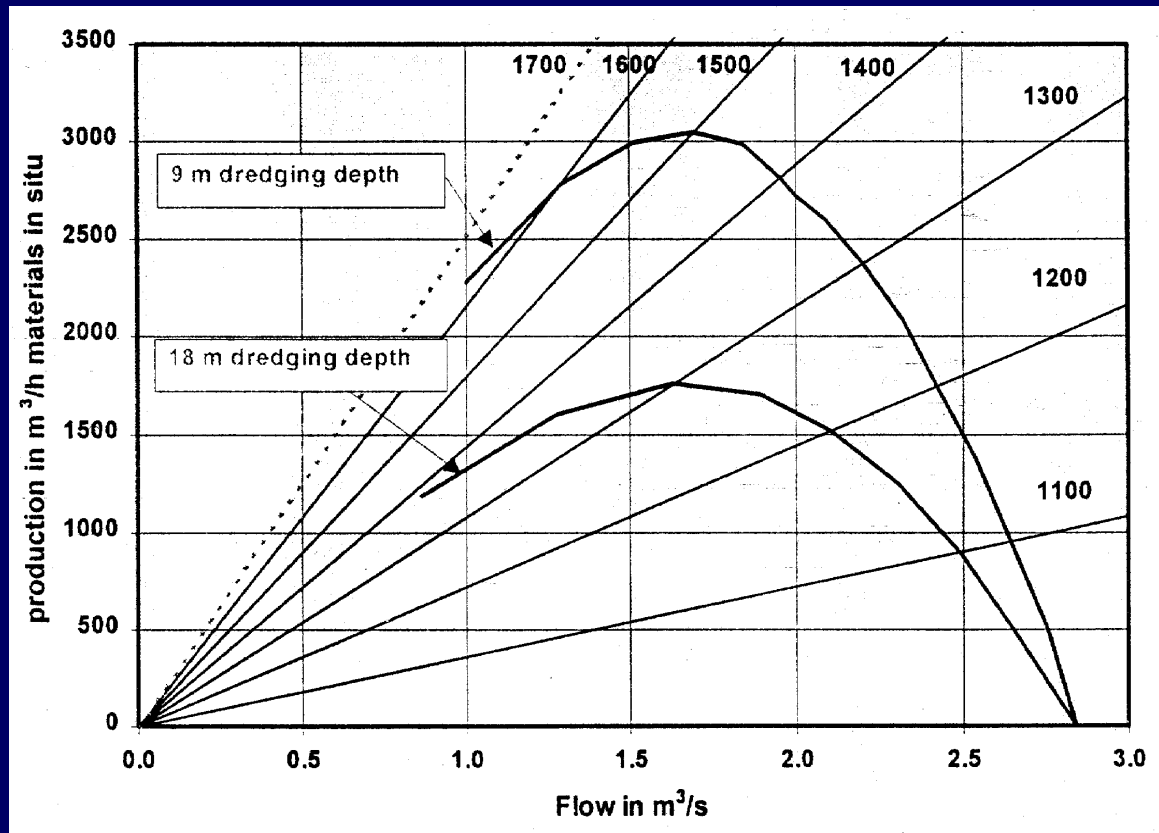
	18 m		9 m	
Density in kg/m <sup>3</sup>	Q <sub>m</sub> m <sup>3</sup> /s	Q <sub>s</sub> m <sup>3</sup> /h	Q <sub>m</sub> m <sup>3</sup> /s	Q <sub>s</sub> m <sup>3</sup> /h
1000	2,840	0	2,840	0
1050	2,659	479	2,756	496
1100	2,491	897	2,644	952
1150	2,309	1247	2,538	1370
1200	2,105	1515	2,422	1744
1250	1,891	1702	2,320	2088
1300	1,627	1757	2,204	2380
1350	1,273	1604	2,089	2632
1380	0,864	1182	2,000	2725
1400			1,956	2816
1450			1,844	2987
1500			1,693	3047
1550			1,511	2992
1600			1,288	2782
1633			1,000	2279

October 13, 2004

7

# PRODUCTION RANGE

## MAXIMUM ATTAINABLE PRODUCTION

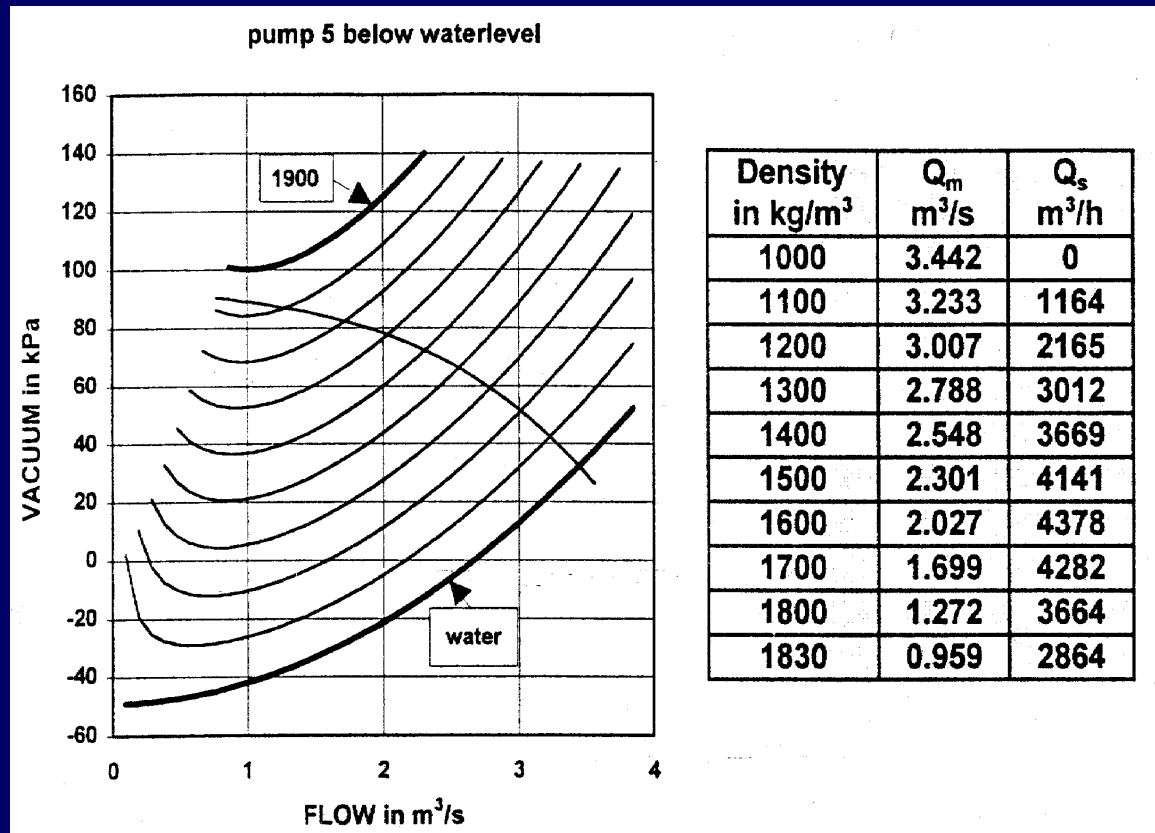


October 13, 2004 **Figure. Production limited by decisive vacuum.  $Q_m$ - $Q_s$  diagram.**



# PRODUCTION RANGE

## OPERATIONAL LIMITS



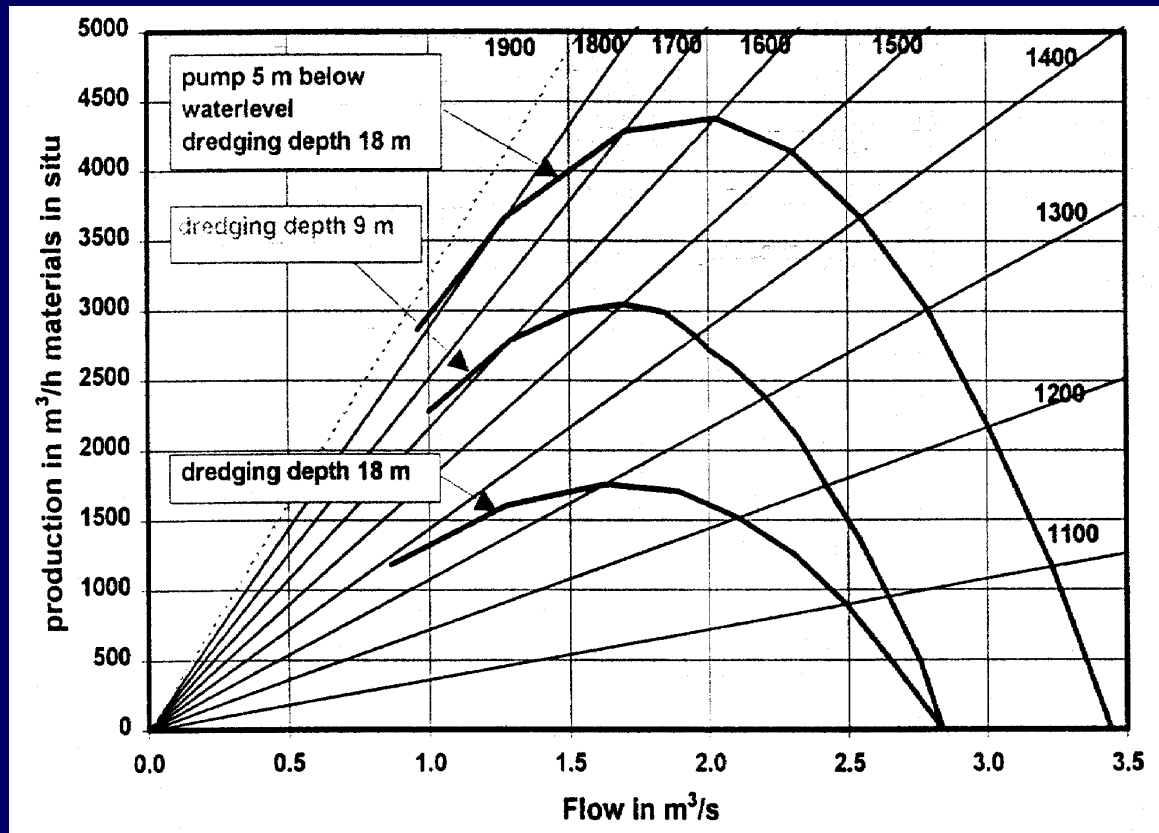
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Decisive vacuum curve & vacuum curves of suction pipe.

9

# PRODUCTION RANGE

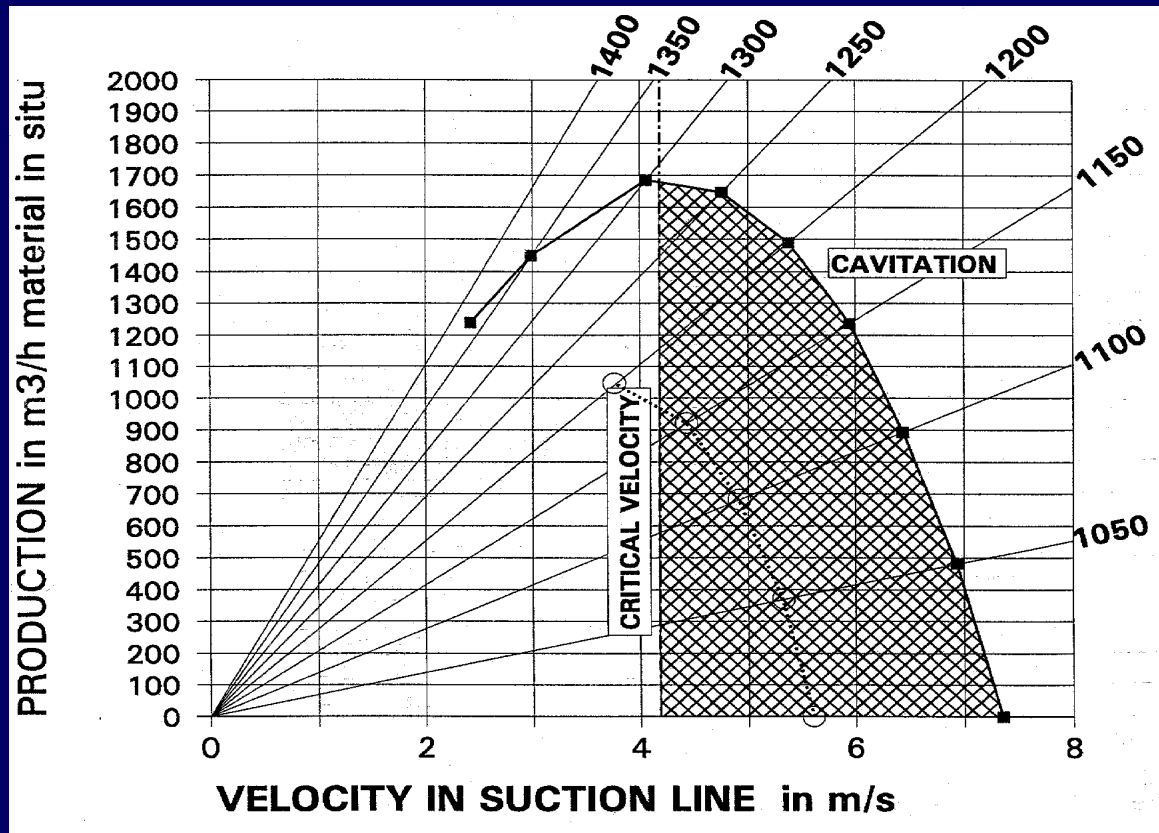
## MAXIMUM ATTAINABLE PRODUCTION



October 13, 2004 **Figure. Production limited by decisive vacuum.  $Q_m$ - $Q_s$  diagram.**

# PRODUCTION RANGE

## MINIMUM ACCEPTABLE PRODUCTION



October 13, 2000 **Production limited by decisive vacuum and deposition-limit velocity.**

11

# PRODUCTION LIMITATIONS

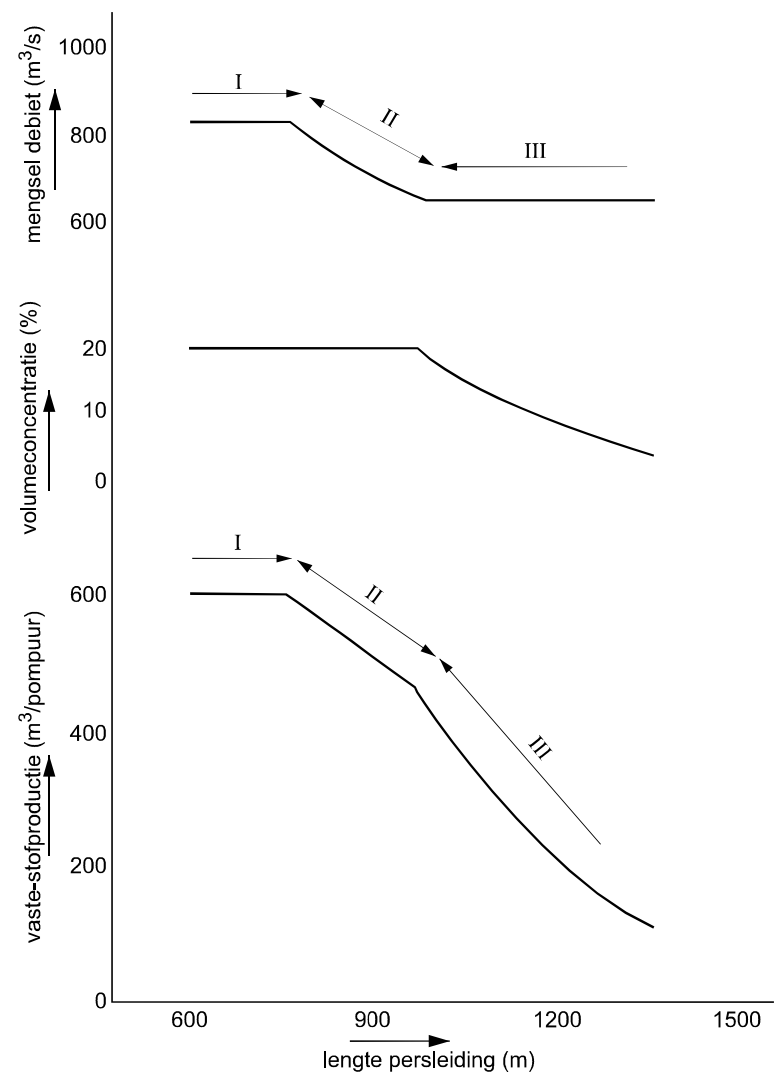
- I. **Too Short Pipeline:** the pump tends to operate outside a normal working range, the pump speed must be lowered to avoid cavitation
- II. **Pipeline Distance Within a Normal Working Range of a Pump:** a pump operates at maximum speed and mixture of maximum attainable density is transported
- III. **Too Long Pipeline:** the pump tends to operate outside a normal working range, the mixture density must be lowered to maintain velocity above the deposition limit in a pipeline

# PRODUCTION LIMITATIONS

I. Too Short Pipeline

II. Pipeline Distance Within a Normal Working Range of a Pump

III. Too Long Pipeline



October 13, 2004

# PRODUCTION LIMITATIONS

## I. Too Short Pipeline

## II. Pipeline Distance Within a Normal Working Range of a Pump

## III. Too Long Pipeline

