Proportioning technology for high-viscous (alcohol resistant and fluorine-free) foam agents: Things to consider

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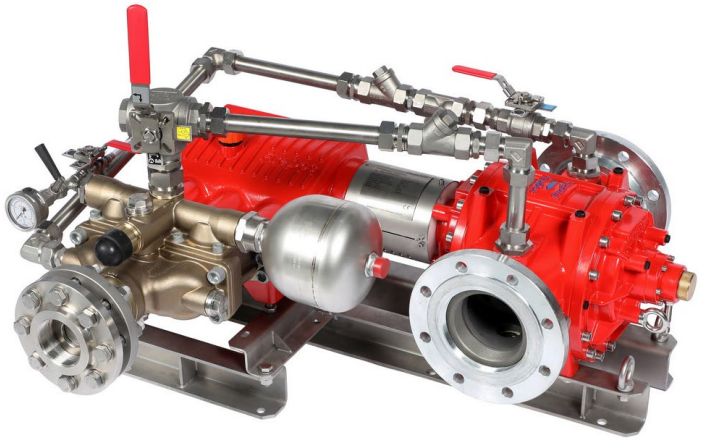
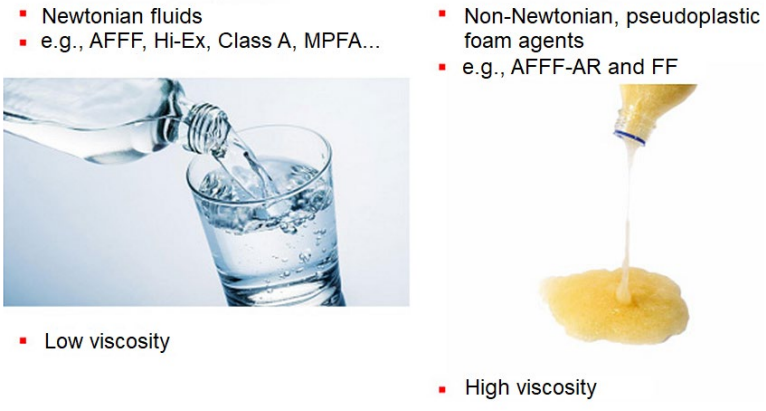


The success in fire fighting depends, to a great extent, on the correct proportioning and handling of foam agents which are used in fire extinguishing systems. Special attention must be paid to the foam agents' physical properties, most prominently, to their viscosity. Highly viscous foam agents have some special requirements to proportioning technology in the course of this.

Ingo Weiss head of sales at FireDos, an expert on foam agent proportioners explained, "The viscosity of foam agents is important because it has a major influence when selecting the proportioning system".



Distinguishing foam agents by their viscosity

The higher the viscosity, the less fluid is a liquid. The lower the viscosity, the more fluid it is. With the viscosity of foam agents, it is distinguished between:

- Newtonian fluids, eg the low-viscous extinguishing agents AFFF, Hi-Ex, Class A and multi-purpose foam agents and
- non-Newtonian fluids, ie pseudoplastic foam agents such as AFFF-AR and FF (fluorine-free foam agents).

The foam agent to be selected depends on the type of intended use or the risk to be protected from. Is it about flammable solids or about fluids? Polar fluids require different foam agents for extinguishing than non-polar fluids do. Also, the depth of the fluid is one decision criterion.

High-viscous foam agents: Which proportioning technology is the right one?

The viscosity of foam agents has a major influence on the correctness of proportioning. Highly viscous foam agents have a significantly higher pressure loss while flowing than low-viscous foam agents do. This rules many proportioning technologies out that are based upon pressure ratios. In turn, such proportioning technologies are suitable where the high-viscous foam agent is delivered by pumps. A grave concern as air entrapment is the biggest problem when handling high-viscous foam agents, displacement pumps are the only suitable pump type suitable for decanting from the supplier container into the proportioning systems foam tank. Off-the-shelf barrel pumps are not suitable as too much air would be trapped during transfer. The high viscosity liquids would prevent this air from escaping, making the foam agent useless. It is important to inspect your delivery prior to decanting to ensure the delivered goods do not already have air entrapped.

Requirements to the foam agent pump: The suction line is what really matters

The foam agent's viscosity influences the pressure loss of a pump significantly while flowing through the suction line. The correct dimensioning of the suction line is therefore crucial for correct proportioning of the foam agent. When considering the most important operating parameters of a pump, the correlation between foam

agent viscosity, pump suction capacity and the suction line diameter, becomes clear:

NPSH value

Every pump has a specific net positive suction head (NPSH) value, also referred to as suction capacity. The value can be taken from the manufacturer's datasheet. It depends on the pump type and the number of revolutions. Putting it simply, the NPSH value is the negative pressure or the pressure drop that the pump generates inside the suction nozzle.

Volumetric efficiency

Flow rate actually delivered in relation to flow rate theoretically delivered.

Dimensioning of the suction line for the foam agent pump

Two limitations must be considered when dimensioning the suction line: Firstly, the maximum permissible flow velocities and secondly, the pressure loss in the suction line.

Flow velocity

Depending on their viscosity, foam agents have different maximum permissible flow velocities. For foam agents with a viscosity similar to water, which is independent of the state of movement (Newtonian fluid, eg AFFF foam agent), a flow velocity of 1,0 to 1,2 metres per second in the suction line should not be exceeded. For pseudoplastic foam agents with a viscosity depending on the state of movement (non-Newtonian fluid, eg AFFF-AR foam), a flow velocity of 0,6 to 0,8 meters per second in the suction line must not be exceeded.

Exceeding the permissible flow velocities may lead to evaporation of foam agent components and the hazard of explosion-like increase in volume, showing as a pressure surge (causing cavitation).

Dimensioning of the foam agent suction line

The suction line of a foam agent pump must be dimensioned in such a way to take pressure losses under different operating conditions into account:

- minimum/maximum expected water flow rate
- minimum/maximum expected foam agent temperature in the suction line

When calculating the dimensioning of the foam agent suction line, several factors must be considered. This includes the height difference between the foam agent tank and the foam agent pump, the foam agent density, acceleration of gravity, the length of the suction line as well as the pressure loss coefficient as a function of the flow velocity and the viscosity of the foam agent and finally the flow velocity.
The following factors for the suction line layout can be influenced:

- h, the height difference between foam agent tank outlet and foam agent pump inlet

$$\text{Max. suction capability of the foam agent pump} \; ! > \text{Suction height}\,[\rho * g * h] + \text{pressure loss}\,[L_{total}/d_i * \lambda * \rho/2 * c^2]$$

h:	Height difference between empty foam agent tank and suction inlet of foam agent pump	L_{total}:	Length of the suction line incl. equivalent length of fittings
ρ:	foam agent density, stated on foam agent producer's datasheet	d_i:	Internal pipe diameter
g:	acceleration of gravity	ρ :	foam agent density, stated on foam agent producer's datasheet
		λ:	Pressure loss coefficient as a function of flow velocity and foam agent viscosity
		c:	Flow velocity

This formula can be used to calculate the dimensioning of the foam agent suction line between tank and pump.

- Ltotal, the length of the suction line
- di, the diameter of the suction line

No pressure loss calculation can be made without indication of viscosity since the pressure loss coefficient is calculated as follows:

However, not only the correct dimensioning of the suction line is crucial. To avoid faults in the delivery of ▸

Gauteng's Modderfontein fire training ground gets new lease on life

The old fire training ground in the heart of Modderfontein in Johannesburg, South Africa, has been refurbished and rebranded FTC Modderfontein.

Under The Public Safety Company, the venue has been repositioned as a neutral, non-competitive training space available to training organisations and companies looking for a purpose-built facility that caters to the needs of multiple fire, rescue and emergency medical disciplines.

"The private training space has evolved over the last few years with prospective students spoilt for choice", says Iain Fourie, managing director of The Public Safety Company. "But what most private companies seem to lack is a suitable training space. So rather than enter that market, we've seen a gap to play a supporting role in making the space available to all." With the challenges faced by municipal facilities and increased bylaw enforcement around pan fires in office block parking lots, the market gap is significant. "We're confident that with well-priced access to FTC Modderfontein, the industry as a whole will have a chance to level up and improve standards across the board."

- the foam agent through the foam agent suction line, the following should be observed:

$$Re = di * \frac{c}{\gamma}$$

Re Reynolds number
d_i Internal pipe diameter
c Flow velocity
γ Dynamic viscosity

For Re smaller than 2350 (laminar flow):

$$\lambda = \frac{64}{Re}$$

For Re larger than 2350 (turbulent flow):

$$\lambda = \left[2 * lg * \left(Re * \sqrt{\frac{\lambda}{2{,}51}}\right)\right]^{-2}$$

Calculating the pressure loss coefficient

- The suction line should be constructed as easy, short and straight as possible. Non-steady piping layouts and blind lines should be avoided.
- Also, a common suction line for several tanks as well as a common suction line for several foam pumps should be avoided.
- In addition, attention should be paid that the foam agent tank connection and all fittings in the pipework have the same size like the suction line itself.
- Furthermore, the suction line must be vacuum-tight (no pressure test).

Conclusion

Viscosity is the most important physical property of a foam agent with regard to proportioning and is decisive for its possible application in the case of a fire. Highly viscous foam agents can be applied efficiently only if the proper proportioning technology, based upon pumps, is used. The correct proportioning of a foam agent depends on the dimensioning of the foam agent suction line. Apart from the correct calculation of the dimensioning, many more parameters must be observed. In practice, it must be ensured eg by short and straight lines that nothing can compromise the delivery.

FireDos GEN III proportioner

With GEN III, FireDos offers a complete proportioner type series for the delivery of highly viscous foam agents. GEN III is a hydraulic-driven foam agent proportioner for fire fighting. The compact and sturdy system is suitable to handle all types of foam agents, even extremely high-viscous, alcohol-resistant and fluorine-free foam agents. In addition, GEN III allows cost-saving and eco-friendly testing of the proportioning rate while no foam is produced, no foam agent is used and no premix has to be disposed of.

DoseTech (Pty) Ltd celebrates 32 years of business this year, first introducing FireDos proportioners into the Southern African market since 2000, with a large number of systems successful installed.