Electromagnetic Flowmeters

Lining Material for Water Applications

White Paper 2009

Introduction

The choice of electromagnetic flowmeter lining material is a potential source of confusion or even annoyance in the water / wastewater industry as a number of different liner options are available on the market, all having their specific properties, strengths and weaknesses.
This paper gives an overview of some basic criteria for choosing lining material for the water / wastewater industry and furthermore provides a short description of the properties, strengths and weaknesses of EPDM, NBR, PUR and Ebonite, i.e. the four types of lining material most commonly used in the water / wastewater industry.

Basic criteria for choosing lining material

Due to the functionality of the flowmeter, a non-conductive lining material is imperative, but other requirements vary according to the specific features of the intended application.

In general, the choice of lining material normally mainly rests on the following criteria:

- Temperature resistance.
- Sensitivity to chemicals added, e.g. on treatment plants
- Mechanical stability, e.g. resistance towards swelling, shrinking or other physical effects of interaction with additives or solvents.
- Robustness and wear resistance

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For drinking water applications, it is furthermore important that the lining material has been tested for:

- Odor and flavor impact (liberation)
- Growth of biofilm
- Extraction of substances of concern to human health (e.g. metals, organic carbon or other trace substances)

A third category of criteria concerns main international drinking water approvals:

- The electromagnetic flowmeter with the lining material of choice must hold the relevant approvals, e.g. WRAS, ANSI/NSF Standard 61, ACS, DVGW, BelgAqua etc.

The four types of lining material describes in the following are all suitable for the water / wastewater industry, but have diverse features making them more suited for some applications than others.

EPDM

EPDM (ethylene propylene diene rubber) is a terpolymer consisting of ethylene, propylene and a non conjugated diene as third monomer.

EPDM shows an excellent resistance against ozone, oxygen as well as polar organic and inorganic chemicals, but lacks resistance to non-polar substances such as solvents, grease and mineral oils. It furthermore has an excellent temperature? resistance and a good low temperature flexibility, which ensures a high performance on a wide temperature range.

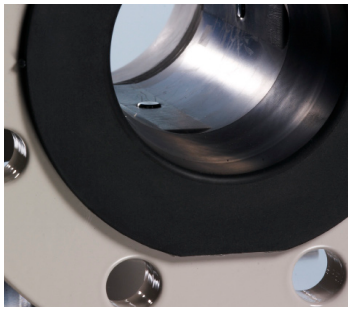
The strength of EPDM lies in its good temperature, weather and seawater resistance as well as in its resistance to polar chemicals. Furthermore, EPDM is not reactive to chlorinated water. These features make EPDM very suitable for all drinking water applications. EPDM fulfills the global requirements of the different drinking water approvals. EPDM is less suitable for wastewater applications due to the lack of resistance towards non-polar substances. This means that EPDM cannot be recommended for wastewater applications. EPDM can be used in process industrial water applications, if there is no hydrocarbon present in the water.

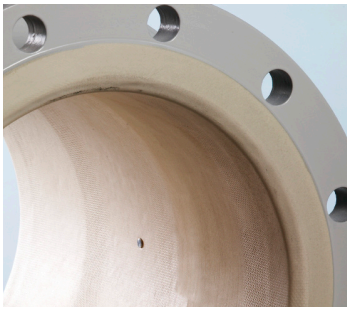
NBR

NBR (nitrile butadiene rubber) is build up of copolymerization of acrylonitrile and butadiene in an emulsion process.

NBR shows an excellent swelling behavior when used with liquids containing non-polar solvents (e.g. mineral oil, grease, tar, gasoline and hydrocarbons). However, compared to EPDM, NBR is less resistant against polar substances, and shows a relative lack of elasticity and low temperature flexibility. The resistance against heat, weather, ozone and oxidizing substances such as chlorine is average.

The strength of NBR lies in its moderate costs, and good resistance to swelling caused by hydrocarbons or acids. These features ensure that NBR is a cost-efficient and flexible all-round lining material fulfilling the needs of most industrial water applications. Furthermore, NBR is very suitable for wastewater applications, due to the resistance to non-polar solvents.
NBR can be used in drinking water applications, but only has an average resistance to chlorinated water. Performance in tests on odor and flavor impact and growth of biofilm is average. NBR can fulfill the requirements for NSF/ANSI Standard 61.





PUR

Polyurethane rubber (AU) or Thermoplastic polyurethane rubber (TPU) is formed by the reaction of polyester or polyetherdiols (soft segment) with diisocyanates.

PUR has a good low temperature flexibility as well as weather resistance. It is very resistant to mineral oil, grease gasoline and aromatic hydrocarbons. Used with acidic and chlorine media, however, it has a low degree of stability. The temperature resistance of PUR is relatively low.
PUR has a good resistance to swelling caused by hydrocarbons. This feature ensures that PUR can be used in many industrial water applications. Furthermore, PUR can be used for wastewater applications, due to the resistance to non-polar solvents.
The low hydrolysis stability of PUR makes it less suitable for liquids containing ozone, chlorine or acid, e.g. treated drinking water applications and process water.

Ebonite

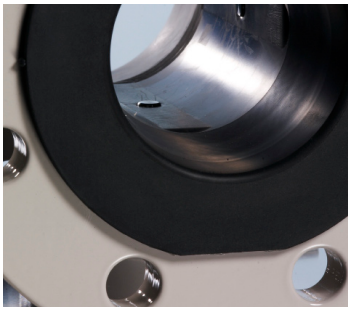
Vulcanized natural rubber.

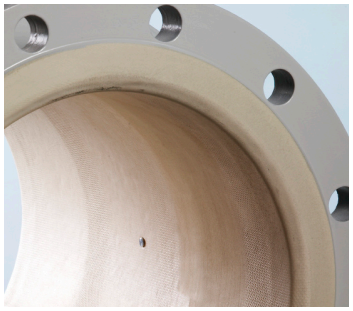
Ebonite is a non resilient material with an excellent resistance to ozone, oxygen, chemicals, and non polar substances such as solvents, grease and mineral oils. It furthermore has an excellent heat resistance, while its low temperature flexibility is average. Resistance to pulsation in flow and changes in pressure is moderate.

The strength of ebonite lies in its resistance to polar chemicals and oxidizing agents such as water based chlorine solutions. This makes ebonite a good choice for drinking water applications. Ebonite fulfills the requirements of some drinking water approvals such as WRAS and ANSI/NSF 61.
Ebonite is very suitable for process industrial water applications and for wastewater applications, due to its resistance towards non-polar substances.

Summary

In accordance with the general properties strengths and weaknesses of the lining material described above, it may be concluded that EPDM can be recommended for all drinking water applications. Ebonite can be recommended as a good alternative, but cannot hold the complete range of drinking water approvals. PUR and NBR can obtain a very limited number of approvals and for that reason cannot be recommended as a preferred liner type.
For wastewater and industrial water applications where hydrocarbons/solvents can be present, NBR and Ebonite are the best fits of the evaluated lining materials, while PUR has some limitations due to its low hydrolysis stability.





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