Diffuser Membrane Material Selection

Bulletin Brief

Membrane media is the determining component of a diffuser. It controls the operating and long term performance capabilities of the diffuser, allowing operation at a reasonable head loss and release of fine, discrete gas bubbles. Proper membrane material selection is critical in achieving desired results. Polymeric compounds are selected and engineered to produce desired surface properties, material stability, as well as environmental and chemical resistance.

Optimum performance of a flexible membrane often directly correlates with proper membrane compound selection. Utilization of the proper compound for the proper application can define the difference between success and failure in a given application. Membrane design and engineering must be tied directly to proper membrane compound selection and application. The polymer type is the primary variable for all membrane compounds. Specific design and engineering of individual polymers can also significantly impact membrane performance, service life, maintenance characteristics, and efficiencies. Control of the overall compound chemistry and compound variables, which include extractable oils, reinforcing fillers and the cure system will improve the stability and long term performance of the membrane.

Technical Presentation

Several polymer types along with their physical characteristics and typical applications are described below. Information listed below is general.

EPDM

Ethylene Propylene Diene Monomer (EPDM) is typically employed successfully in most municipal and many industrial applications. EPDM has a history in the wastewater treatment industry of providing excellent physical characteristics, including weathering and aging, ozone resistance. EPDM is non-polar which provides very good resistance to polar materials such as water, ketones and alcohols. EPDM has excellent heat age properties and is effective in temperatures as low as of -60°C and up to 170°C (depending on the cure system). EPDM is not flame resistant and has poor performance in the presence of aliphatic or aromatic hydrocarbon oils.

Polyurethane (PU)

Polyurethanes are made up of either a polyether or a polyester backbone. The polyether types, alone, are used in wastewater applications. Polyurethanes are typically used in applications where EPDM would be an inappropriate choice, such as the presence of hydrocarbon oils and aromatic solvents. Industrial wastes such as some pulp and paper applications, food processing applications, etc. are often good applications for the use of PU.

Industrial wastes (some Pulp & Paper applications, food processing applications, etc.) are often good applications for the use of PU. The temperature range is typically minus 30°F to 175°F. Concentrated acids, ketones, esters, etc. can attack and damage PU. High Temperature PU is available for special applications above the operating range of EDI premium PU products.

Nitrile (NBR)
Nitrile is a copolymer of acrylonitrile (ACN) and butadiene with the ACN content ranging from 18% - 40%. NBR offers very good solvent and oil resistance as it is a very polar polymer. It is this polarity which gives it low resistance to polar solvents and, in some cases, water. It is an unsaturated polymer and thus is susceptible to heat and ozone. Nitrile would be typically used in oily or greasy wastes. Its temperature range is -40°C to 120°C.

Hydrogenated NBR (HNBR)
HNBR is a saturated version of Nitrile rubber and has significantly improved resistance to heat, ozone and chemical resistance. It would be used in specific applications for chemical resistance as it is very expensive. The temperature range would be -30°C to 150°C.

Silicone
Silicone is significantly different from other polymers in which the normal carbon-carbon bonds are replaced with carbon-silicone-oxygen bonds. This chemistry makes it very resistant to heat, ozone, electrical current and some chemicals (strong bases). Its surface chemistry offers excellent release characteristics. Silicone would be used in high temperature applications or with specific chemical compatibilities. It is susceptible to degradation by solvents, oils and concentrated acids. The major advantage of silicone is the very high heat resistance; its temperature range is -65°C to 315°C. If high temp may be of limited value as piping systems have the critical design temp of approx 150°F to 180°F (60°C to 82°C) temperature limited.

Silicone Blend
Silicone blended with other polymers such as EPDM has similar characteristics to premium EPDM compounds.

Neoprene
Neoprene is a chlorinated butadiene polymer. It is very resistant to ozone, acids, fats, greases and aliphatic oils. Neoprene is susceptible to degradation by strong acids and ketones as well as aromatic and nitrogen containing hydrocarbons. It would generally be used in petrochemical, meat processing or oily/greasy wastes. The temperature range for Neoprene is -40°C to 120°C.

Fluoroelastomers (FKM)
Fluoroelastomers are polymers which are very resistant to most chemicals, oils and heat. This is due to its unique chemistry in which the carbon-hydrogen bonds are replaced with carbon-fluorine bonds and the high instauration of the polymer. It is susceptible to some nitrogen containing compounds. It would be used in some select petro chemical applications, as the polymer is very expensive. The temperature range for the FKM's is -40°C to 200°C.

POLYMER	LOW TEMP	HIGH TEMP	RESISTANT TO	ATTACKED BY
EPDM	-60°C	150°C – S 177°C – P	Heat, Oxygen, Ozone, Animal and Vegetable Fats	Solvents, Aromatic Hydrocarbons
Fluoroelastomers	-40°C	200°C	Oils, Acids, Chemicals, Fuel and Oxygen	KETONES, Low MW Esters,
Silicone	-65°C	315°C	Heat, Ozone, Oxygen, Concentrated Bases	Solvents, Oils, Acids
POLYMER	LOW	HIGH	RESISTANT TO	ATTACKED BY

	TEMP	TEMP		
Nitrile	-40°C	120°C	Oils, Fuels, Fats, Hydrocarbons	Ketones, Esters, Aldehydes
Polyurethanes	-68°C	80°C	Oils, Solvents. High abrasion Resistance	Acids, Ketones, Esters
HNBR	-30°C	150°C	Heat, Ozone, Oils, Chemicals	Ketones, Esters, Aldehydes
Neoprene	-40°C	120°C	Ozone, Acids, Fats, Greases	Acids, Ketones, Aromatic Hydrocarbons

Environmental Dynamics Inc. can manufacture any tube membrane in any diameter, any length, any perforation pattern, and practically any polymer through special order. Advanced technology EPDM and polyurethane for most diffusers on the market are stock items. Disc replacement membranes are also available in various polymers through special order.

For specific information on aeration system selection considerations, contact EDI at 573-474-9456.