Impedance Heating

FEATURES AND BENEFITS GUIDE

HEATREX

THE PIPE BECOMES HEATER

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Contents

For additional information about impedance heating systems refer to the Impedance Heating Systems Catalog.
For additional engineering information regarding impedance heating systems refer to “Understanding Impedance Heating” Chemical Engineering, May 1986.

Impedance Heating

Introduction

An Impedance Heating System is a unique, safe, and proven method for pipeline heating. The pipe actually becomes the heating element when low AC voltage is applied to it by a special, custom designed transformer.

HEATREX can provide single source responsibility for design, hardware and start-up assistance for an impedance system to heat gasses or fluids through your pipeline. Impedance Heating can also be used over a wide range of temperatures to prevent freezing in cold weather, maintain fluidity of viscous materials, and raise the temperature of heat sensitive materials or maintain gas temperatures up to 1600° F.

Application Information

Impedance Heating Systems heat a wide variety of gases, liquids and viscous materials which are stored, pumped and processed in many different industries and applications. Impedance heating can be used in three basic ways:

Cold Start: Heat is applied to increase fluidity of static, viscous materials so they can be pumped. Typical materials include asphalt, molasses, and heavy fuel oils.

Maintain Temperature or Pipe Tracing: Heat is applied to a liquid or gas flowing through a pipe to offset heat losses. Typical applications include freeze protection or maintaining the fluidity of viscous materials.

Temperature Rise: Heat is applied to a liquid or gas flowing through a pipe in order to raise its temperature between the inlet and outlet of the heater pipe. Typical applications include heating corrosive liquids or high temperature process air.

Customer List/Application List:

CUSTOMER	MATERIAL HEATED	TEMP (°F)	PIPE LENGTH (FT)
Allied Chemical Corp.	Coal Tar Pitch	450	131
Allied Fibers Corp.	Superheated Steam	1040	70
Aluminum Co. of America	Pitch	170	1155
American Hoechst Corp.	Polypropylene	400	22
Amoco Oil Co.	Fuel Oil	280	891
Amoco Oil Co.	Zinc Chloride	700	53
Arco Oil & Gas Co.	Crude Oil	150	15700
Atlantic Richfield	Salt Water	40	802
Barnard & Burk	Sulphur	265	70
Bethlehem Steel	#6 Fuel Oil	280	891
Bouligny Co.	Superheated Steam	845	34
British Petroleum Alaska	Water	40	611
Brown & Root Inc.	Crude Oil	50	1270
Catalytic Corp.	Liquid Pentasulfide	752	2
Celotex Corp.	Asphalt	400	1760
Certain Teed Corp.	Asphalt	480	52
Chemtex Inc.	Polymer	536	52
Chevrolet Motor Div.	Catalyst	70	770
Colgate Palmolive Inc.	Sulphur	300	165
E.I. Dupont	Process Gas	575	170
Emery Industries	Stearic Acid	160	370
Ethyl Corp.	Powdered Catalyst	450	53
Exxon Research & Engineering	Heavy Fuel Oil	950	552
Exxon Synthetics Inc.	Coal Slurry	370	558
Fisher Scientific Co.	Resin & Hardener Mix	194	40
Fortifiber Corp.	Asphalt	500	250
Foster Wheeler Corp.	Paraffin	60	1020
H.K. Ferguson	Pitch	735	100
Hershey Foods Corporation	Chocolate	110	377
Honeywell	Air	1200	114
Inland Steel Co.	Fuel Oil	160	8500
Intalco Aluminum	Air/Tar Mixture	500	52
International Paper	Wax	185	520
Kaiser Aluminum Co.	Coal Pitch	380	500
Kitchens of Sara Lee	Nulomoline	100	325
Koppers Co.	Enamel Filling	375	85
Layton Engineering	#6 Fuel Oil	125	550
M & M Mars Co.	Chocolate	120	1400
Medusa Cement Co.	#6 Fuel Oil	150	700
Mobil Pipe Line Inc.	Wax	145	93
Monsanto	Montar	752	230
N.L. Industries	Magnesium Chloride	1300	95
National Starch & Chemical	Wax	210	300
National Starch & Chemical	Wax/Resins	100	1400
Nestlé	Chocolate	110	263
Pillsbury Haagen Dazs	Sweeteners	120	180
PolyOne Elastomers & Performance Additives	Oil	180	350
Procon, LTD.	Sulphur	285	890
Rohm & Haas	Process Vapor	1100	26
Shell Chemical Co.	Process Fluid	500	41
Sherwin Williams, Inc.	Pitch	500	140
South Carolina Electric	Sulphur	110	1350
SPEC Process Engineering & Construction Inc.	Isocyanate	120	400
Stauffer Chemical Co.	Phosphorous Pentasulfide	707	30
Sun Oil Company	Sulphur	290	485
Tennessee Eastman	Polymers	320	1165
Trimount Bituminus	Asphalt	325	425
Union Electric Co.	Wax	212	612
Upjohn	Isocyanate	120	476
Vulcan Material	Caustic	750	360
Western Electric Co.	Thermoplastic Rubber	300	900
Yabucoa Sun Oil Co.	Pitch	400	2300

Features

Uniform Heating – Because the entire pipe effectively acts as the heating element, heat is generated uniformly throughout the entire length and circumference without hot spots.

Simplicity – The impedance method takes the complexity out of pipeline heating. A few basic components comprise the entire heating system. Installation is simple; the system can be installed without disturbing most of the existing thermal insulation.

Wide Temperature Range – HEATREX has pioneered the use of impedance heating for applications ranging from below freezing to 1600°F. It is often the only viable option for high temperature pipeline heating.

Close Temperature Control – Thermocouple sensors placed along the pipeline provide precise, uniform temperature control. Optional SCR controls give the ability to achieve control within +/- 1°F. Other electrical systems claim to be self-regulating, even this method is inefficient and can not maintain the control tolerances achievable with an impedance system. Steam systems are often left running continuously with little regard to temperature control. The usual reasons given are since there is always a danger of reduced temperatures, heat is required constantly, and no control is needed. This is false and costly thinking, because overheating can cause serious problems to the product or the process, as well as wasting large amounts of energy.

Low Cost – Installation costs are kept to a minimum by the inherent simplicity of the system. Likewise, maintenance is virtually eliminated; many systems operate unattended. Energy costs are low because the required energy is concentrated in the pipe and efficiently heats the fluid or gas traveling through it.

No Failures – When the pipe becomes the heating element, burnouts and failures associated with electrical resistance tapes and cables, steam tracing, and steam jacketing are eliminated.

Impedance Heating

Benefits over other Methods

Low Voltage Operation – All systems operate at less than 30 volts, many at 10 volts or below. HEATREX systems meet or exceed the requirements of the National Electrical Code (Article 427) pertaining to impedance heating, assuring safe operation. At 30 volts or below impedance heating systems are inherently safe, as this low voltage is below human perception and will not transfer through the human body.

No External Fluids – Pipeline heating with steam or high pressure temperature fluids introduces a high degree of complexity and a potential hazard. Steam system components fail, these failures can lead to dangerous environments for work personnel. Impedance heating accomplishes the same result in a simple, straightforward manner.

No leaky Jackets – With impedance heating, you won't have leaky steam lines, cracked steam traps, pump failures or frozen condensate return pipes.

No Hot Spots – Impedance heating eliminates the danger of overheating temperature-sensitive materials (asphalt, chocolate, heavy syrups) because hot spots associated with conventional pipe tracing are eliminated. This results from the consistent pipe material, conducting the exact same amount of heat through the entire system.

No Routine Maintenance – Routine maintenance is eliminated, along with the replacement parts and production shutdowns associated with such maintenance.

Reduced Energy Consumption – Impedance heating concentrates all heat within the pipe, which effectively transfers directly to the product traveling through the pipe. Other pipe heating systems must compensate for losses from transferring heat through either a cable insulation jacket, a steam tracing pipe, or a clamp-on style system. These systems must also be oversized again to compensate for the losses associated with transferring heat through the pipe wall. Many systems must double the watts per linear foot, or btu's / hr per linear foot to compensate for these losses. It is not uncommon to see other systems oversized as much as 100% of an HEATREX impedance system. This over-sizing of a pipe heating system causes other systems to operate unnecessarily and leads to unwanted energy consumption.

Design Recommendations

Midpoint vs. Endpoint – There are two basic types of impedance heating connections. These are the end-point and mid-point connections.(Figures 2 and 3, HEATREX Impedance Heating Systems)

The end-point electrical connection is best suited for complex piping systems where multiple branches or “tees” are installed. There is no need to electrically balance the system, as with a mid-point connection, which makes design and installation much easier.

The mid-point system does not require electrical isolation at the pipe ends. Twice the length of pipe can be heated over an end-point system at the same secondary voltage, because the pipe is divided at the mid-point. This connection is best suited for straight or simple runs where the electrical mid-point can be easily determined.

Pipe Construction – Impedance heating is only suitable for conductive materials. Non-conductive materials, such as plastic pipe, are not suitable as they will not conduct the low voltage provided by the system. In general, the less conductive a material is, the better the less the energy required to create heat in the pipe. In conjunction with the material conductivity, the thinner the pipe wall, less energy is required to produce heat. Therefore, materials such as carbon steel and black iron with thin walls will require systems that consume less energy than material such as copper with the same wall thickness.

Pipe Length – Pipe length should be considered when designing a “cold start” or “temperature rise” system. In general, the longer and smaller the pipe, the less energy required to control the process. The system will be smaller in size compared to the same process using either a shorter pipe length or bigger pipe diameter.

Summary of Impedance Heating

Impedance heating efficiently, accurately, and simply heats pipes and processes. No other system available can match the precise temperature control, consistent heat throughout a system, and minimized operation due to efficient heat transfer. Impedance heating systems are simple to install, are inherently safe due to the low voltage of the system, and are virtually maintenance free. An HEATREX Impedance Heating System return on investment can not be matched by any other system. The simplicity of installation, elimination of routine maintenance, and efficiency of the system will bring the fastest return on investment compared to any other system available.