MAGNETIC FLOWMETERS: APPLICATION AND MAINTENANCE

Bruce H. Thompson
President
Thompson Equipment Company, Inc.
New Orleans, Louisiana

ABSTRACT

This paper presents the application, maintenance and trouble shooting techniques of magnetic flowmeters. The advantages and disadvantages of pulsed DC (direct current) meters vs. AC (alternating current) meters are discussed. Various liners and electrodes are compared.

The cause of failures and the correction of these will be discussed. The view point is that of a repair facility and not a manufacturer, as a result the internals of a wide variety of models, manufacturers, and designs have been observed and repaired. The cause of failure is determined before the meter is rebuilt in order to recommend remedies to the client.

At this writing there are 24 manufacturers of magnetic flowmeters and before press there may be more at the rate the list is growing. Most of the designs are similar with minor variations in manufacturing techniques, however, these techniques make worlds of difference in the application and reliability of the meter.

Most mag meters basically consist of a non magnetic tube usually with an insulating liner of some plastic material, a set of coils with armature, terminal blocks, a housing and electronics.

Each of these components will be examined separately based upon the results of the thousands of mag meters that have been examined and rebuilt.

First let's look at the basic requirements for a good mag meter installation.

1. A conductive fluid.
2. A full pipe.
3. A ground from the fluid to the meter body at both the inlet and outlet of the meter.
4. An earth ground to the meter body.
5. A separate conduit for the signal cable on AC Meters.
6. Liner and electrode materials compatible with the fluid composition and temperature.
7. A moisture proof seal between the conduit and the meter.
8. Other considerations vary according to manufacturer but should not be overlooked, such as proper velocity range and fluid coating characteristics.

Some of the above considerations are eliminated by the use of integral electronics or the use of pulsed DC in place of AC excited meters, however, there are prices to be paid for each of these alternates.

The pulsed DC meter has the advantage of a stable zero and lower power consumption. It is an excellent meter in many application, however, and there is a BIG HOWEVER, it will NOT take the place of many AC meter applications particularly in a paper mill. DC meters are sensitive to pulp stock entrained solids and air causing noise at the electrodes. This noise can be dampened, however the amount of dampening required may slow the response time an objectionable amount. Changing conductivity such as the injection of a chemical upstream of the meter can cause wild oscillations. An empty pipe may cause saturation of some amplifiers so that the meter will not respond for several minutes after flow commences. Additional electronics on the meter body can be sensitive to lower temperature limits causing intermittent failures as variable capacitors open and close. These objections do not apply to an AC meter, however, an AC meter must be zeroed with a completely full pipe and no flow.

The importance of grounding a mag meter cannot be overemphasized. Occasionally we receive meters that are in perfect shape but would not work in the field. Usually the culprit is shoddy grounding techniques. The signal from each electrode is referenced to ground and an improper ground can cause a significant error. Check it prior to depending on it as a good ground.

The fluid itself frequently carries transients so be sure to run a ground strap between each, REPEAT EACH, meter flange to each adjacent pipe flange. Do not depend on the bolts to provide this ground as they corrode, the ground is lost, and you will be wondering what has gone wrong with the meter.

If the connecting pipe is plastic, use a grounding orifice on each end of the meter connected to the adjacent meter flange. If the material of this orifice is too expensive, there is an alternative. There is an amplifier circuit that can be used between the meter and the converter that eliminates the need for a fluid ground.

Liner and electrode selection is important. Most manufacturers issue guides for this selection. Get a copy and use it. Remember, however, do not use Tantalum in caustic soda service. Many meters are received for repair that originally had Tantalum electrodes that were used to measure black liquor flow. I said originally had Tantalum, because we receive them with holes where the electrodes had been. Although the liner may be okay it must be replaced because fluid has leaked behind the liner.

Liner selection seems easy, but there are considerations. Teflon is almost universally used in chemical and paper mill service. But beware, there are various grades of teflon and various methods of forming it into tubing or pipe. Practically every reputable manufacturer of mag meters in this country and some in Europe use an isostatic molded PTFE teflon made in the United States. Although this teflon is not as cheap as PTFE pipe formed by paste or ram-extrusion it is worth its weight in gold in a mag meter. Isostatic molded teflon has the characteristic of retaining its memory through higher temperatures.

This is very important as the teflon tube is pressed into the smaller metal tube with several tons of force thus deforming it to a smaller diameter. The teflon wants to get back to its original shape and consequently presses against the tube through it's entire periphery. Extruded teflon loses its memory as temperature increases and no longer is bound to the tube except by the electrodes. This is the major source of mag meter failure; electrodes leaks; so stick to the highest quality teflon.

Don't buy a cheap mag meter and think you are saving money. You will end up throwing it away or relining it with the proper teflon.

The above does not apply to a material called ETFE or Tefzel* which is molded into the spool. This can be used on smaller meters, however, the temperature limit is 100° lower than the PTFE material. Tefzel is also not as universally resistant to chemicals as PTFE.

Liners fail for several reasons; mishandling during installation, abrasion, leaking at the electrodes, and cleaning with steam.

Gaskets are furnished with every meter; use them. Do not depend on the liner itself to be the gasket. Several manufacturers provide flange protectors which protect the liner during installation but these do not prevent abrasion at the inlet. An orifice protector shaped like a hat that extends into the meter is frequently furnished to extend liner life.

Cleaning meters in the line with steam is an acceptable method, but be sure the line is open to atmosphere or install a vacuum breaker, otherwise when the line cools the steam will condense and pull the liner out of the meter. This is a frequent cause of failure.

Beware of extra electrodes used for grounding. Two electrodes are required for the signal and they are the potential trouble spots. They are necessary; don't create more problems by using more electrodes than absolutely necessary.

Polyurethane is an excellent liner in its place, but its place is not in a paper mill except on water. We recently converted over 50 meters from poly to teflon at a new mill because some engineer thought he was going to save money by specifying poly liners.

The housing seems simple enough; they are usually aluminum and stand up against outside weather. But outside weather is not the only problem, leaks from pipes overhead can dissolve a casing in a matter of hours.

The housing can also be a fire hazard when metering certain fluids like hydrochloric acid where aluminium and the fluid react to form hydrogen. An electrode leak into the housing releases hydrogen which we all know is highly explosive. The fluid also attacks the coils which are not intrinsically safe and we then have a bomb in the plant. Two such explosions have occurred at a large chemical plant in Texas. For this reason a fiberglass housing has been designed for the more popular brand meters thus eliminating the bomb hazard and the problem of overhead leaks.

We have saved the simplest problem but the most important for last and this is protection of the terminals. The slightest moisture on the terminals can interfere with a low level electrode signal. Terminal compartments are frequently filled with fluid by condensation in the electrical conduit. A moisture proof seal at each conduit connection is a must.

The main things to look for have been outlined when installing magnetic flowmeters, and the principal causes of failure have been pointed out based upon 15 years of examining flowmeters sent to us for rebuild. If you consider the source of problems and the suggestions to minimize them made herein we are confident you will reduce your maintenance costs and find the magmeter one of the simplest and most reliable flowmeters available today.

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