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Unraveling the MYTHS AND MYSTERIES of Induction Sealing

By William F. Zito

High frequency. Low frequency. Ferrites. Air-cooled. Water-cooled. Solid state. Vacuum tubes. Microwave. Anyone who has attempted to buy an induction sealing system has been inundated with these terms and many more. There has been a plethora of articles written discussing the technical aspects of induction cap sealing. Many of theses have appeared in this Journal, and the uninitiated many want to refer to these to gain information not covered in this offering. The intent of this article is to separate fact from fiction concerning induction sealing in a way that anyone can understand and to offer suggestion to assist in selecting the proper equipment.

Closure with foil inner seal

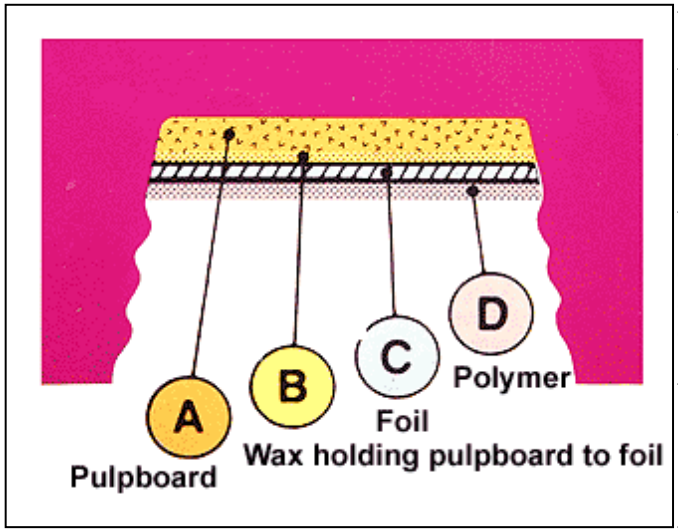

Figure 1

Notice I referred to the induction system as a heater and not a sealer. This clarifies the fist misconception. Everyone who manufactures induction equipment for affixing a foil innerseal on a container refers to the generators as induction sealers. The truth of the matter is that we do seal anything. The only function of the induction system is to heat the foil. You can heat the foil as much as you want, but if it is not in intimate contact with the lip of the container, you will not achieve a seal. Occasionally, I'll receive a call from a customer who tells me something is wrong with his induction sealers. He goes on to tell me he has run 100 containers under the induction sealing head and only 97 of them sealed. I explain that if 97 of them sealed, there is nothing wrong with the induction system and suggest he look elsewhere for the problem.

Since the inception of induction sealing in the mid-60's, frequently referred to as induction cap sealing there has been an almost mysterious aura surrounding this phenomenon. Most of the mysteries and misinformation have been generated by the manufactures and sellers of this equipment.

Just what is induction sealing and what can it do for you? Induction sealing is a non contact heating process that accomplishes the hermetic sealing of a container with a closure that includes a heat-sealable foil laminate. The typical induction innerseal begins as a multilaminate liner inside a closure. It consists of a layer of pulpboard, a layer of way, aluminum foil and a layer of polymer that is compatible with the bottle material and capable of heat-sealing to the lip of the container **(Figure 1)**

When the closure is placed onto the container and is passed through an electromagnetic field produced by the induction heater, several things occur. An electromagnetic current, called an eddy current, is induced into the foil portion resulting in a resistance-type heating effect. The heated foil melts the wax layer, which is absorbed into the pulpboard, releasing the foil from the pulpboard, and the polymer coating melts, hermetically sealing the foil to the lip of the container **(Figure 2)**

Closure and inner seal after sealing operation

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Further examination usually uncovers the fact that there was insufficient torque on the three containers that did not seal. Either the foil was not in intimate contact with the lips of the containers, the lips of the containers were deformed or the caps were cocked.
If a series of identical containers are put through an induction field and one of them seals, then all of them should seal. You must realize that when you are dealing with hundreds or thousands, if not millions, of containers and caps, you will experience an occasional bad lip, insufficient torque or cocked cap. When this occurs, poor seals cannot be blamed on the induction equipment.

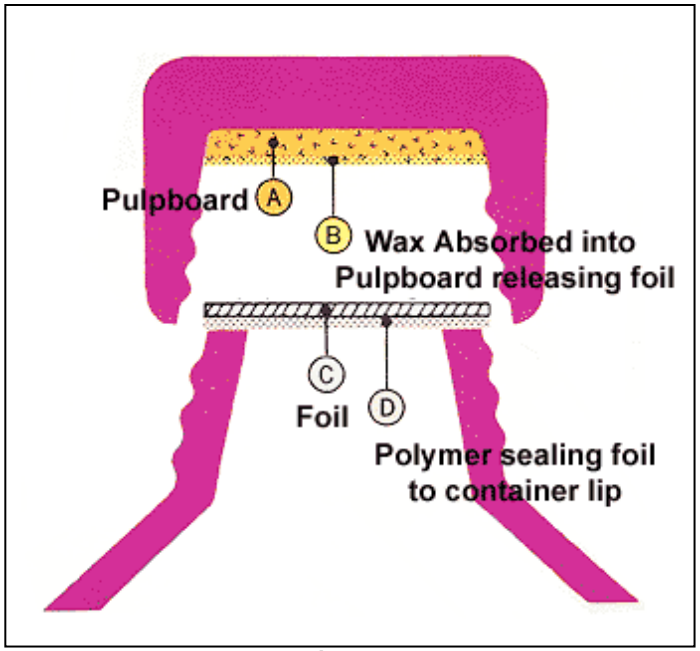

Figure 2

What about frequencies? The high frequency/ low frequency confusion was initiated by the manufactures of vacuum tube equipment The very first induction systems for heating foil where vacuum tube units, state-of-the-art at that time, which operated at approximately 450 kHz. As more modern devices were developed, many suppliers introduced solid-state generators that operated in the 26-100 kHz range. The makers of equipment who resisted change and continued to build vacuum tube system began referring to the two systems as high –frequency and low-frequency, rather then vacuum tube and solid state, which would insinuate their equipment may be old fashioned and not state-of-the-art.
There has been much written about the advantages of low- versus high-frequency induction equipment. It's almost a moot point at the time, since there are very few, if any vacuum tube systems fail and become high-maintenance items; they are being replaced with solid-state systems.

In late 1988, a major manufacturer of induction sealing equipment announced the development of what they said was a radically new power supply. They said that because of load matching and variable frequency, their unit would out perform power suppliers of higher KW rating supplied by their competitors. In addition, this unit was advertised as air-cooled. Reports from the field indicated that because of reliability problems and failure to perform at advertised sealing rates, a number of theses units have been returned to the manufacturer by dissatisfied customers. One other point: Although the power supply and high voltage leads do not require water cooling the sealing coil requires a water system costing over $2,000.00. SO much for air cooled systems. There is of course the possibility that the manufacturer will work the bugs out of this system and it may become a viable alternative in the future.

Most makers of induction systems mislead customers by advertising their equipment as being air-cooled. This lead people to believe they do not need any water for cooling. While there are air-cooled power supplies available from all of the major suppliers, all production systems require water to cool the sealing heads where undesirable heat is produced by the current going through the copper tubing that produced the electromagnetic field. The bottom line is that all induction systems require water for cooling, except for small lab-type systems that are used on an intermittent basis.

Coil flux without ferrities

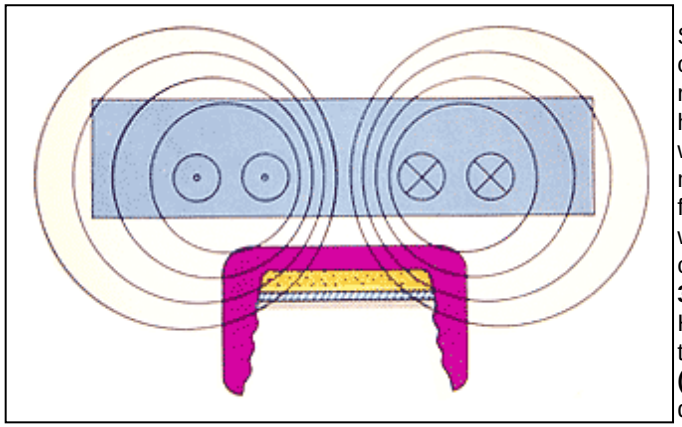

Figure 3

Some manufacturers of induction sealing systems tout their use of ferrites in the sealing head, as if this is something new and radically different. Ferrites are nothing more than dense homogeneous ceramic structures made by mixing iron oxide with oxides or carbonates of one or more metals such as manganese, zinc, nickel or magnesium. They are pressed then fired in a kiln at 2000 ° F and machined as needed. How and why are they used in induction cap sealing? If you examine the cross section of an induction-sealing coil with out ferrites **(Figure 3)** the electromagnetic field radiates equally in all directions.
How and why they used in induction cap sealing? If you examine the cross section of an induction-sealing coil with out ferrites **(Figure 3)** the electromagnetic field radiates equally in all directions.

Coil flux with ferrites

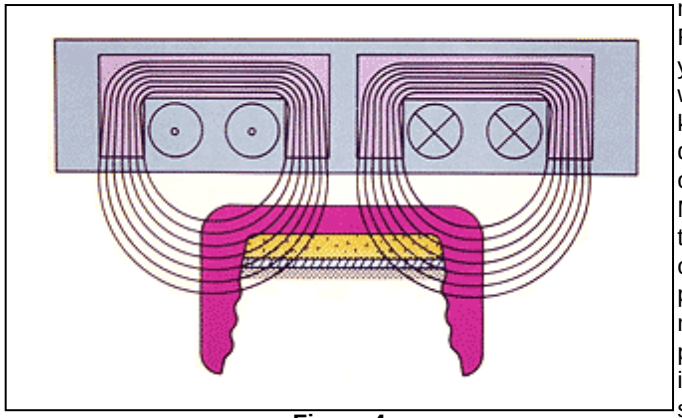

Figure 4

By surrounding the coil with a ferrite material **(Figure 4)**, the dense ferrites percent the electromagnetic ferrites material filed from radiating and actually concentrates and direct the filed making it more efficient.
Ferrites have been in use as flux concentrates for over fifteen years and are certainly nothing new. Ferrites cannot be used with vacuum tube systems because the high frequency (450 kHz) causes excessive heat in the ferrites. This phenomena does not occur in the solid-state power system which normally operates in the 26-100 kHz range.
Many people who are packaging liquid products are concerned that they will not achieve a good seal if there is product on the lip of the container when it is capped. Not to worry; this is not a problem. Normally the torque applied to the cap will squeeze out most of the liquid, and the heat generated by the induction process will eliminate whatever is left between the lip and the inner seal. Many times I have taken WD-40 lubricant and sprayed the innersole and lip of the container and then induction sealed them with out any problems.

How can you tell which system is right for you? Most people will receive quotations from three or four different manufacturers; all saying their equipment is the best. The further confuse things, the prices are generally not more then a few hundred dollars apart. The truth is there is very little difference among the systems sold by the major sources of induction equipment. Generally, if you send samples to all of the major suppliers seals and , after getting your samples back, mix them up, I doubt if you will see any differences in the seals.

This is not to say that there are not special applications where one manufacturer has an advantage over the others because of special coil design or other application knowledge. However, there special applications are such a small percentage of the overall industry as to be insignificant.

So what's a buyer to do? How does he know whom to believe? Little is accomplished by asking a manufacturer for references. Good sources of information are your suppliers of closures, bottle or induction inner seal materials. They have not axes to grind and for the most part can be objective. They are constantly in the field and usually know if a company has a reputation for reliability and good service, which is really what you are looking for.

You should also take a very close look at the warranties offered by the various suppliers. Service can be extremely expensive if you don't have problem with you equipment. Don't fall into the parts and service trap. Several companies advertise free parts and service on equipment for a period of one year after your installation. 2KW.Another company offers two different warrantees in its quotations; one covers the equipment for six months and the other for eighteen months. So you see it can be very confusing. It's to your benefit to ask questions about each company's warranty. It could save you a bundle of money. One excellent way of comparing equipment is to personally visit each suppler.

Finally, let's look at the bottom line. The vast majority of induction sealing systems sold today use solid-state devices that operate at low frequency, below 100kHz. All suppliers offer air-cooled power supplies but require some minimal water cooking for the sealing coil. Major differences between suppliers do exist in terms of pre- and post-sale service and in some areas of warranty. The rules haven't changed. To be a smart buyer, read the proposal carefully investigate the vendor's reputation for product quality and service as well ask a lot of questions.