What is New in Induction Welding via The Emabond® Process

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Emabond Solutions, LLC located in Norwood, NJ USA offers a new line of Solid State RF Generators with flexible power-delivery systems. These power-delivery systems utilize a faster, higher-precision RF technology to offer enhanced product and process reliability in a plastic assembly design suitable for demanding environments. The new RF power delivery system platforms deliver superb performance in their electromagnetic welding / bonding process for Induction Welding Solutions to provide a tenacious, non-violent heat fused bond.

Emabond has been in business for over 30 years and has been solving a broad range of Plastic Assembly challenges using Electromagnetic Welding / Bonding Systems and compatible polymers for Heat Fusion Energy.

The process has often been considered as the ideal method for critical high performance applications where the cost of failure of the weld is of great concern. Recent technical advancements with flexible power-delivery systems are opening up new and exciting application opportunities making Emabond an innovative assembly method to consider for your new product design challenges. Many of the perceived and real limitations of the process have now been effectively eliminated or greatly reduced which presents many new application opportunities.

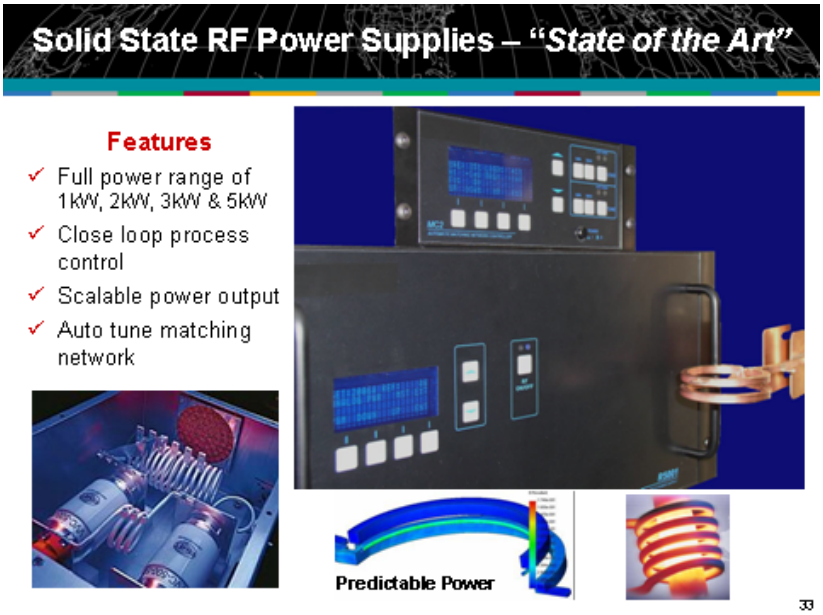
What is New? The Game Change!

The new line of Solid State RF Generators with flexible power-delivery systems has advanced the technology by offering welding process control and feedback. Historically, Emabond was offered using tube type generators that operated at variable frequency ranges from 2 MHz to 8 MHz. These unintelligent tube type generators offered limited

feedback capability unlike the new RF generators and power-delivery systems which utilize sophisticated RF-conversion technology to offer enhanced customer product design capability and a controlled process. The new Emabond power-delivery system accurately controls the application of energy at the bond line. The new Emabond RF generators with flexible power-delivery systems are FCC compliant and CE Approved. The immediate advantages include;

- Precise control of energy at the bond line, including ramped power stages or pulsing of power.
- Minimal or no heating of none plastic components such as metal and delicate electronics that may be closed or captured within the weld line at time of assembly.
- Flexible moving power application packages that can allow for spot welding and/or continuous scanning of a bond line.
- Wider overall power spectrum currently from 300 watt to 5kw with lower power with a future broader range of power.
- Lower overall system and operating cost savings.

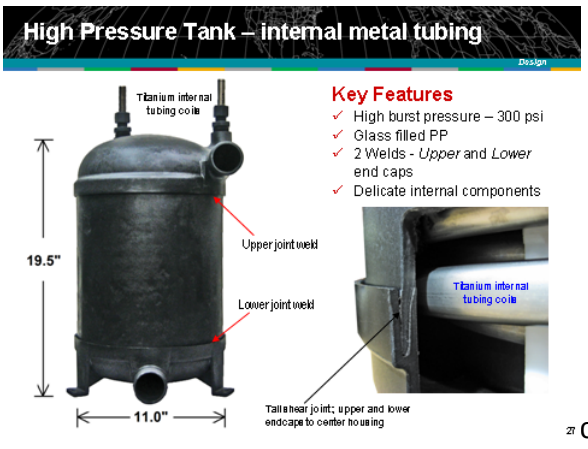
Slide below illustrates the principal components that comprise the flexible power-delivery systems. The matching network (Match NW) is the key component that can be remotely located and or moved to cover a wide range of industrial requirements. The RF Generator is programmable and the Controller provides self diagnostics and a multitude of process control capabilities on the welding process.



Advancement from a Static to a Dynamic Welding Process

Prior Emabond RF Power supply delivery was considered to be static process – similar in many ways to other forms of plastic welding such as ultrasonic, laser, hotplate and vibration. Parts were generally held stationary in a fixture while energy was applied either via friction or external thermal sources. The advent of the flexible power-delivery system has allowed for parts to be moved while under pressure within a fixture while the RF energy is uniformly applied. Emabond is now offered as a **"*dynamic process*"**! The power source can travel with the welded part or the part can pass by a fixed RF power source. The process provides non-contact, non-violent application of energy to a wider range of part geometries.

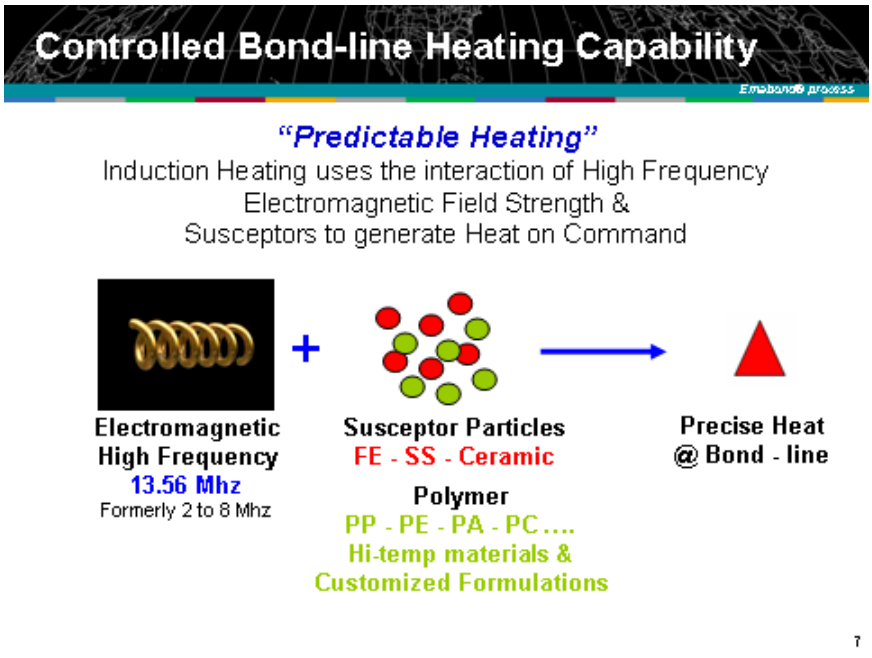
The two slides below illustrate one of the recent systems that were designed to perform multiple welds sequentially to assemble a high pressure vessel. The part is transported under pressure during the assembly process to sequentially weld an upper and a lower and cap to create a high performance pressure tank.



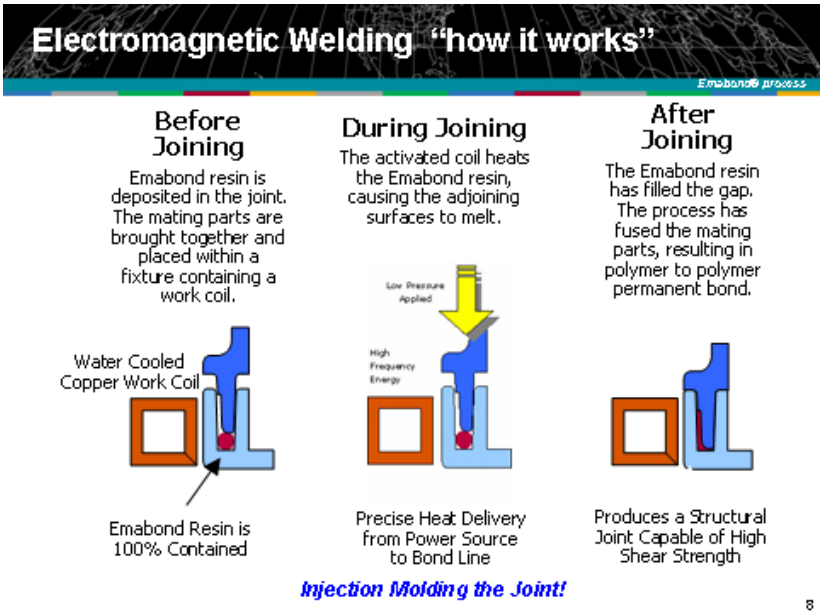
What is the Emabond Process?

Emabond uses high frequency induction energy coupled with conductive or electromagnetic materials to deliver heat precisely to a bond line to provide superior welding of virtually all thermoplastic materials. The process also joins certain dissimilar materials, highly-filled thermoplastics and flexible-to-rigid substrates. It also meets or exceeds the most demanding temperature, leak-proof and pressure-tight and aesthetic requirements. From the base resins and polymers that weld the system together to the specialty additives and equipment that control the fusing heat at the bond line, Emabond Solutions supplies the technology and performance to help their customers design the innovative products demanded in today's marketplace, as well as tomorrow's.

The Emabond process as illustrated in the slide below uses the interaction of High Frequency Electromagnetic Field Strength and Susceptor particles to generate Heat on Command to weld virtually any thermoplastic material.



How does Emabond work? The following slide illustrates the "*before'* – "*during*" – "*after*" phases of a successful weld created within a typical tongue and groove joint design. Joint designs can also be flat to flat, flat to groove and step. The tongue and groove joint offers the greatest versatility, especially when leak proof and high pressure results are required.



Before Joining – the Emabond preform is deposited in the joint. The mating parts are brought together and placed within a fixture containing a work coil which conforms to the weld line geometry. This phase is easily automated or operator initiated.

During Joining - The activated coil heats the Emabond resin, causing the adjoining surfaces to melt. Energy is only consumed during the actual heating cycle which typically is between 1 to 30 seconds. Low clamping force is applied via the specially designed fixture to allow efficient transfer of melt temperature to the substrate.

After Joining - The Emabond resin has filled the gap. The process has fused the mating parts, resulting in a polymer to polymer permanent weld. Note the compact joint cross section when compared to frictional or thermal methods of assembly which typically require broader land area and or flash traps. Emabond is a non-contact, non-violent method of assembly that is gentle on your parts.

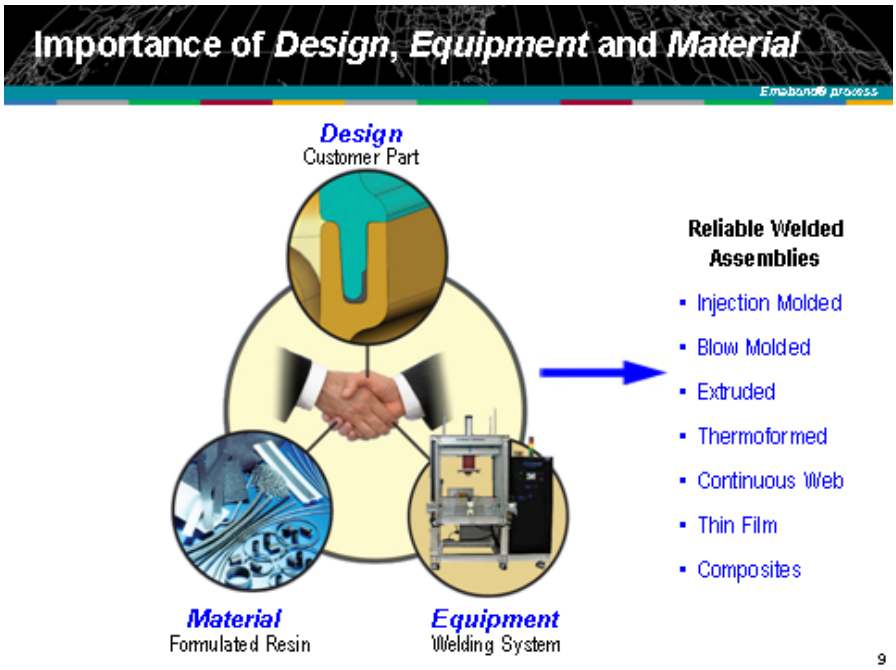
Greater Application Design Flexibility and Process Control

The Emabond Process is designed to meet a broad range of Plastic Assembly challenges from product design to the manufacturing floor.

Successful projects using Emabond require optimization of three principal influences;

1. Application **Design** - for component and joint design and material design selection
2. Emabond **Material** Formulation - the material composition and perform configuration
3. **Equipment** Design and Integration – for production implementation.

All three aspects must be working in harmony to provide optimum performance to provide a robust and reliable process. Each of the three key aspects are described in greater detail below.



Application Design

- Optimum joint design to achieve physical and cosmetic requirements for the end application
- Welding with internal metal components
- Mechanically capturing additional internal components within a structural joint
- Welding of higher temperature thermoplastics
- Welding of highly glass reinforced materials.
- Uniform welding of irregular geometry's

Emabond Material Formulation

Emabond materials are custom formulated to meet the needs of each application performance requirements. It is a blend of conductive or ferro-magnetic fillers such as iron for example with a thermoplastic carrier that is fully compatible with the substrate materials.

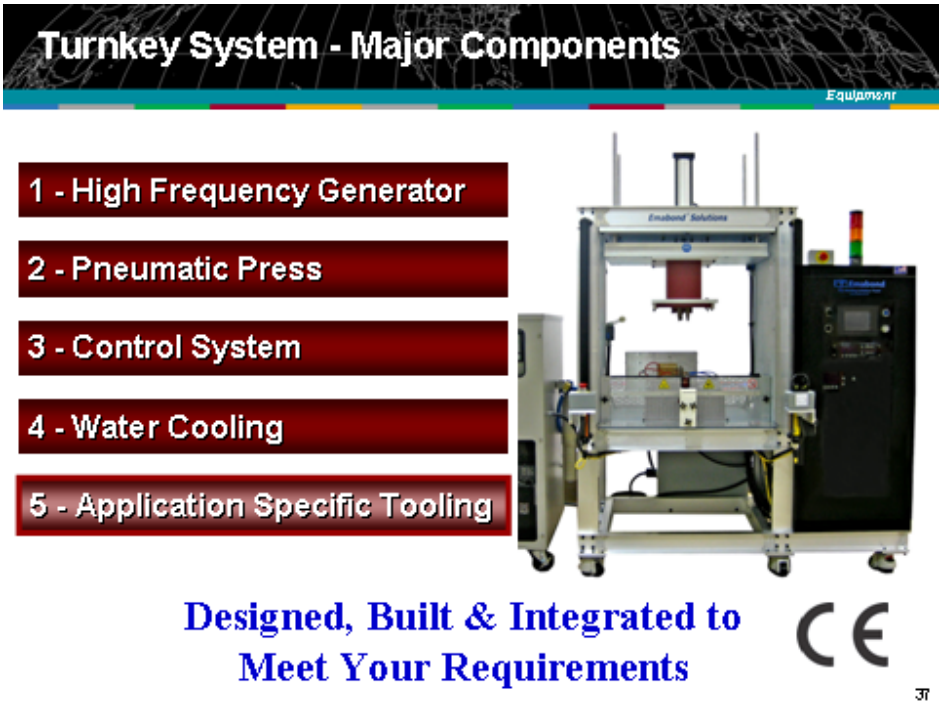
- Wider range of thermoplastics that can be formulated into Emabond performs
- High performance susceptor particles that improve heating efficiency and perform geometry and melt characteristics.

The recent use of ceramic fillers has allowed for more exacting control of temperature and overall composite thickness. Emabond materials are provided as extruded profiles,

sheet, tape and ribbon and can also be provided as injection molded gaskets or co-injected or co-extruded directly onto the substrate.
Emabond provides the specific know-how to custom engineer a solution to meet the demanding requirements for unique applications.

Equipment

Each system can be custom engineered to meet the specific requirements of the customer and application. There are 5 key components that must be optimally designed to achieve the desired results.



Emabond Solutions offers a wide range of advanced capabilities that can be engineered to meet the requirements of very demanding applications and environments.

- RF generators with flexible power-delivery systems for wider range of power outputs
- Power process controls with data acquisition
- Flexible RF cabling that allows for scanning of long and irregular bond lines
- Multiple weld lines performed simultaneously
- Quick-change welding fixtures for multiple applications.

- Side-by-Side dual press systems –that offers flexibility to weld at nearly 2x rate or two unique applications using the same piece of equipment, see below example;

Conclusion

The use of higher performance thermoplastics has created assembly application challenges that include;

- high structural loading often with highly glass reinforced materials
- vessels with high internal pressures and long term cycling
- complex assemblies having internal metal components or sensitive electronics
- continuous welding of sheets and films

Emabond's new RF generators with flexible power-delivery systems offer a highly efficient, compact, easy-to-integrate source of Induction welding power for a wide variety of process applications. Their highly reliable power supplies enhance process flexibility, deliver a wide operating power range for optimized process control, ensure high process repeatability, and improve throughput. Think about Emabond if you are producing a high value part that cannot fail or when you have delicate components contained within a plastic structure or vessel.

Contact Emabond Solutions, LLC for more information

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