A E G I S

Application Engineering Gas Injection Systems

Technology Bulletin

Date: May 1, 2010

RE: Advanced Resin Evacuation Techniques – The Facts

Priority: High

Substantial confusion and deliberate obfuscation has existed for approximately 20 years regarding resin evacuation methods involving gas assisted injection molding. Resin evacuation in gas-assisted molding has also casually been called "spillovers" or "overflows." The purpose of this document is to explain the various methods, clarify what is proprietary and what is not, explain the advantages and disadvantages of the various processing techniques, and to provide our recommendations for resin evacuation *when* it becomes necessary.

1) What is resin evacuation? (or spillovers, overflows)

Resin evacuation is a process enhancement and additional step to conventional gas assisted molding where, following delivery of resin to the mold cavity, *some* of the resin is expelled from the cavity with nitrogen gas. (Or water in the case of water assisted injection molding)

2) Why expel resin from the cavity? There are *limited* circumstances when resin should to be evacuated from the cavity in gas-assisted molding:

A) When the part design requires a flow channel extending to the most distant location in the part cavity. Note that a flow channel in a nominal wall molding is first a runner, built-in to the cavity. If resin fills the cavity to the most remote location in the cavity, gas cannot displace this resin and must be evacuated. This condition can often be avoided by improving or modifying the part design.

B) When a reinforcing material in the base resin (glass fiber, calcium carbonate etc.) would appear on the Class A surface in the typically low-pressure gas assist process. In this case, the cavity is first packed full with resin, "burying" the reinforcing material, then, the warmer central mass of resin is evacuated from the cavity.

C) When a "hesitation line" cannot be eliminated by process adjustment. A hesitation line is a visible surface defect that can occur when the resin flow-front stalls following the injection of a "short shot" of resin and before the gas injection phase continues the resin flow. This is *not* as common of an occurrence with gas injection controllers marketed for the past 10 to 12 years.

D) When a flow channel (gas channel) is desired to have an improved internal geometry. Properly implemented, the internal diameter can be modified to some degree (but without precision) by controlling the timing and rate of resin evacuation. This purpose is not a common cause for selecting resin evacuation. Note that purpose can *only* be achieved with AEGIS' recommended PREP3 process.

E) To confine the gas flow path in the cavity to the desired area while avoiding gas penetration into adjacent thinner sections of the cavity.

3) Don't most gas assist molding programs use resin evacuation?

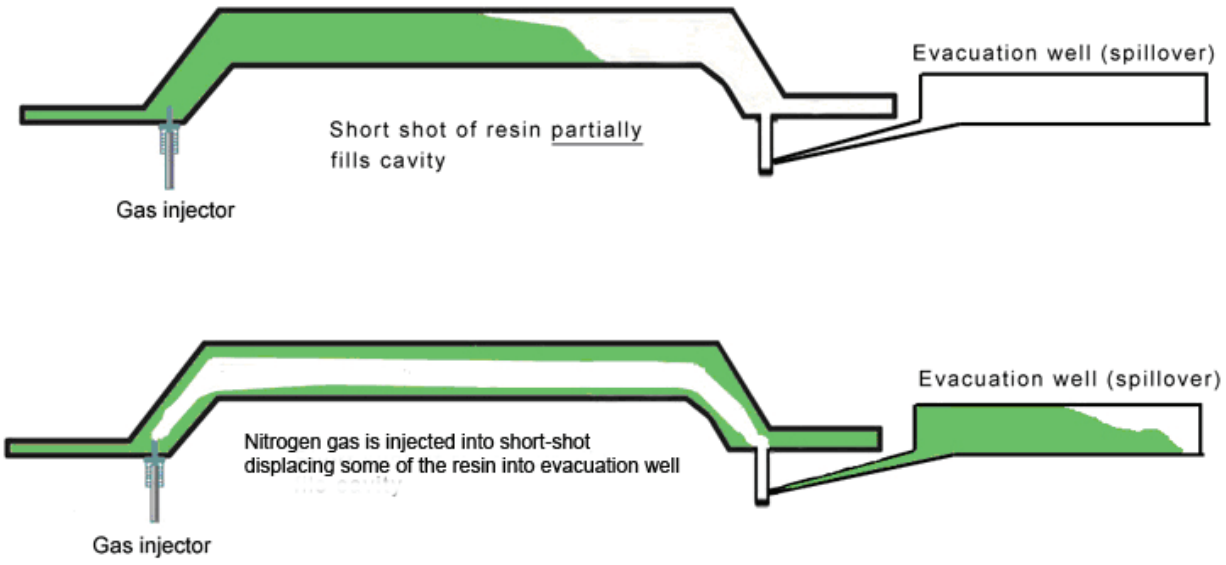
No, this is a commonly heard misconception. Resin evacuation is *not* a routine processing technique, but is an option to be used *only* when processing capabilities, part design and/or resin selection prevents acceptable results with conventional gas assist injection molding. We have seen *numerous* gas molding programs with evacuation wells in the mold when it was unnecessary. We believe most of these unnecessary resin evacuation provisions are implemented so a "technology provider" can steer the molder to a costly, unnecessary "license." In some circumstances, it is just a result of inadequate support from the molders system or technology provider.

4) Isn't a license necessary from a gas assist technology provider when using resin evacuation/spillovers?

No, except in some *very* limited circumstances. There has been long-term misunderstanding, deliberate misinformation, lawsuits, illegitimate harassment of molders and a *serious* lack of accurate information regarding this subject. Many molders over the past 10 to 15 years have *voluntarily* paid for a license regardless of how they were evacuating resin, due to a threat of litigation. We've even heard patent attorneys say to their clients "you need to decide whether you want to spend $25,000.00 for a license or pay $250,000.00 for litigation costs. (so much for ethics) *Too* often, we've seen molder paying for a "license" they did not need just to limit costs and make the threat go away. The confrontations were almost always illegitimate, resulting in the ongoing, long-term confusion in the molding industry. As of the publication of this document, most of that problem has gone away.

5) What basic types of resin evacuation are there?

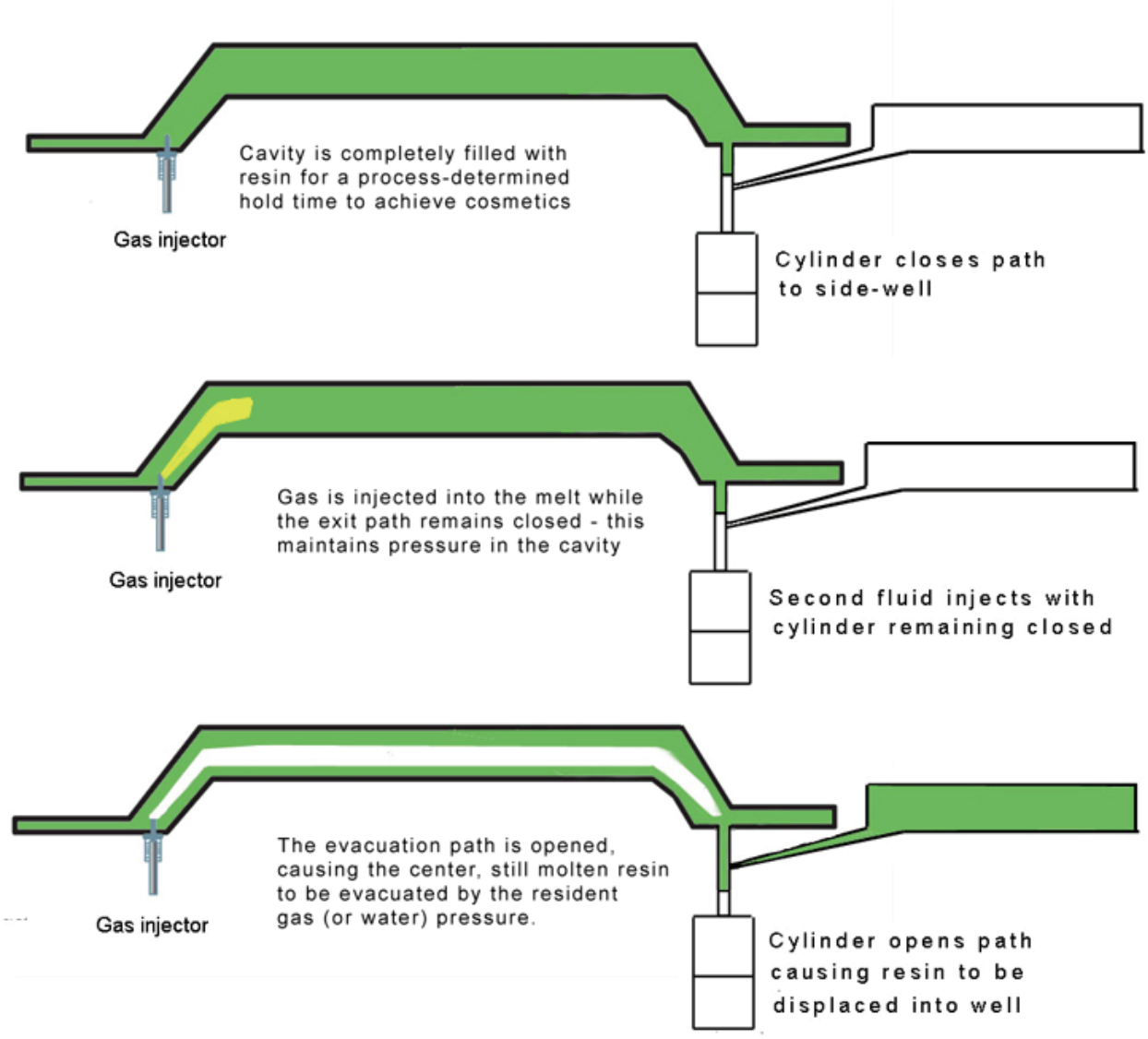
A) The oldest resin evacuation technique is a two-step gas assist process: 1) Short-fill a cavity with resin, with an open aperture for resin evacuation, 2) inject gas, which evacuates some of the resin through the open aperture from the cavity. (reference US patent 5,098,637) This is a method that works only in the rarest circumstances due to the method's inconsistent results. It *was* a patented method, and the patent most commonly used for harassment of molders (even though the technique *was not being used*). This patent is now expired (in July 2008) in the U.S. We recommend avoiding this method in *any* circumstances due to its inferior, inconsistent results for resin evacuation. A parallel patent in Europe held by the same firm as 5,098,637) was found, in 2009, to be invalid due to dubious filing of the application. If you paid for a "license" to practice this method, we suggest you *demand* a refund. A graphic representation of this method is shown below:



The image above shows a cavity only partially filled with resin – this was an integral part of the "patented" gas assist process. Why a short shot? A short shot was necessary to prevent an uncontrollable amount of resin exiting

the flow path, or remaining in the part cavity. In the mid or late 1980's this was state-of-the-art, but has long since been replaced with far superior methods. This technique should be avoided.

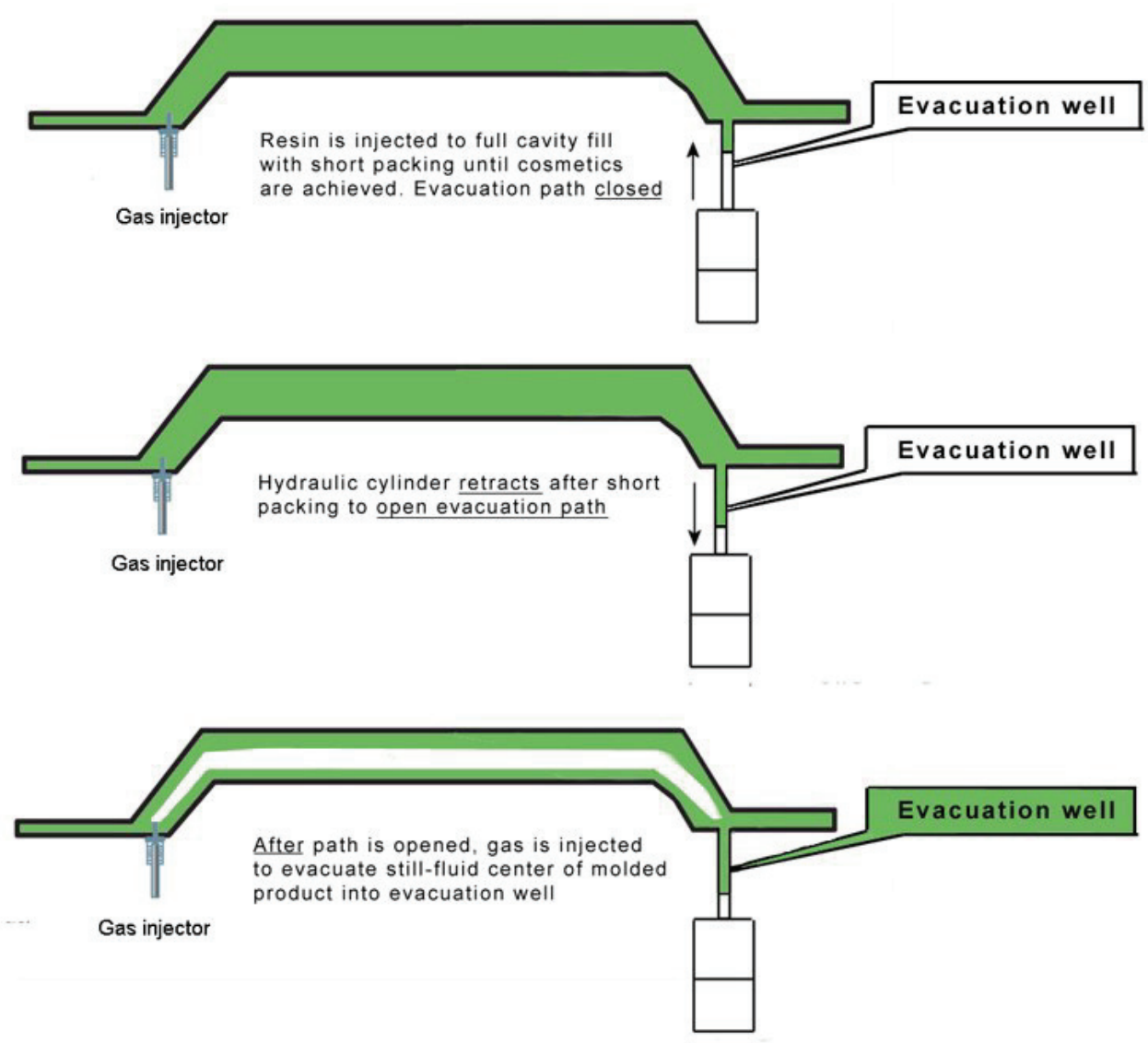
B) In April 2004, U.S. patent number 6,716,387 was issued, and assigned at that time, to Alliance Systems, a company owned by the same principals as Alliance Gas Systems. The methods defined in this patent greatly improved the resin evacuation process with *numerous* resin evacuation methods. The techniques per this patent involved injecting resin into a mold cavity with no *open* aperture, and with various methods for *selectively evacuating* resin after the injection of gas (or water). The technique also included resin evacuation from the resin *runner*, hence its trade name "Backspill." There have been several slight enhancements to the methods described in this patent since 2004, but in no cases do the methods include an *open* aperture during the resin injection phase. All methods (claims) for the patent also require injection of gas (or water) before "selective" evacuation, meaning the opening of the discharge point from the part cavity remains closed during the gas, or water, injection phase!



Please note that the method described *above*, if performed to the patent(s) specific process parameters, is a proprietary process. This should be taken into consideration prior to implementing these specific methods, as a *costly* license may be required.

C) The resin evacuation technique which achieves the *most consistent* results and highest-level quality of molded product with the widest processing window. AEGIS calls this method PREP^3:

Remember again that the most common reason for implementation of resin evacuation is to achieve superior Class A surface cosmetics. The method described below achieves the highest level of consistent results and surface quality, and is available for implementation by any gas assist molder *without* a license!



Note that in the above-described process, Class A cosmetics are achieved by imposing molding machine pressure throughout the cavity prior to the gas injection phase. This packing phase timing is determined during process development – if a thicker remaining wall is desired, the pack time is increased; hold time is decreased if a thinner remaining wall is desired. This method is also used to pack nominal wall portions of the cavity adjacent to the intended flow channel to prevent gas penetration into those thinner areas.

It is AEGIS' position that the method described immediately above is superior to all other resin evacuation methods – it affords the most consistent results with the widest processing window, and is a process that is available without licensing from *any* gas assist patent holder!

A note about the evacuation wells themselves: We frequently hear remarks such as "doesn't the evacuation well need to be gassed also?" or "doesn't the evacuation well need to be solid?" The proper answer is no to both questions. What is important is 1) the evacuation well is filled adequately to prevent the injected gas from escaping the parting line in the evacuation well, and 2) a *consistent* amount of resin is displaced, shot-to-shot,

each molding cycle. If variable amounts of resin are displaced into the evacuation well, there are variable amounts of resin remaining in the part cavity.

The evacuation path to the evacuation well: There are various designs for the evacuation path to the evacuation well. For the best results, we recommend a sub gate to a post, with a hydraulic (not pneumatic!) cylinder in the extended (forward) position keeping the sub gate path to the post closed during resin injection. After the full-cavity packing time, the hydraulic cylinder retracts, extending the length of the post and exposing the sub gate to the extended post, allowing the resin to flow, upon gas injection, into the evacuation well.

The recommendations in this document are generic to provide the basic concepts only. AEGIS' can assist with specific details for injector placement, evacuation point location, and the details of the evacuation provision and evacuation well for your specific application. We'd be pleased to review your application and recommend the most efficient and cost effective method for new, or conversion gas assist molding program.

Please contact us for additional information and let us know how we can help you achieve the most efficient, cost effective gas molding process possible.

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