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Why Do Coffee Bags Vacuum  
Pack Themselves On Airplanes &  
Sometimes By Themselves? *(part 2)* •

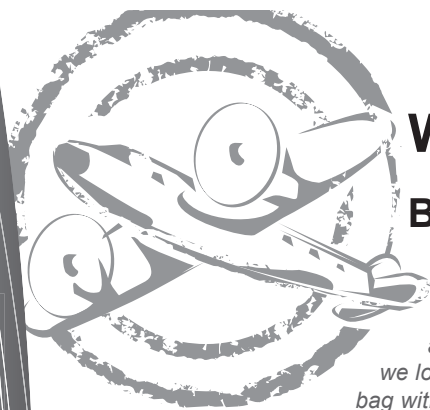
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# WHY DO COFFEE BAGS VACUUM PACK ON AIRPLANES & SOMETIMES BY THEMSELVES?

Part 2 – The Mysterious Case of the Missing Gas

In Part I of this Article "Airplanes and Mountain Passes" we looked at how a coffee bag with one-way degassing valve, which is normally soft on

the store shelf, can become vacuum packed and hard-to-the-touch due to external pressure changes in airplane cabins and high elevations as seen on highways through mountains. But there are instances when coffee bags become vacuum-packed without being moved by an airplane or a truck. These bags are packed with fresh coffee, are properly sealed, and are soft for a period of days or even weeks. Everything seems normal, but then after some time they feel hard and are, in fact, vacuum-packed. What can cause a bag to vacuum pack without any negative, outside influences? How can an innocent bag of beans start out soft and nice and then turn into a hardened, vacuum packed bag? Was it motivated by vengeance, greed, or passion? PBI coffee packaging detectives are on the case.

If a coffee bag originally had enough gas to make it soft and at some later time the bag is hard, the gas that was in it has now gone somewhere. But where did it go? One possibility might be that, unnoticed by us, the gas was squeezed out of the bag by the weight of other bags pressing on it during shipping or storage. This is feasible, but often can be ruled out. Another possibility might be that the bag was heated and it expanded like a hot air balloon thus causing the coffee gas to be pushed out of the valve. It then may have cooled, causing the bag to contract around the beans. But yet again, this factor can usually be ruled out. The perplexed coffee detective is left scratching his head.

Over the years some people have suggested that the one-way degassing valve may be the culprit. It is, after all, the device responsible for gas exchange between the inside and the outside of the bag. Although it is understandable why someone might look to the one-way degassing valve as a suspect, it has an ironclad alibi. It is impossible for a one-way valve to actively create a vacuum inside the bag. The one-way degassing valve is a passive device. It is like the storm door you may have on your house. The door can be opened by you pushing on it so that you can get out of your house. Sometimes the wind may grab the door and pull it open, but it cannot grab you and force you to leave your house. The one-way degassing

valve is similar. It lets coffee gas out of a bag when the gas creates a positive pressure and pushes open a rubber disc that releases the excess coffee gas. After enough gas leaves the coffee bag to rebalance the pressure in and out of the bag, a drop of oil in the valve acts like that little cylinder or spring "closer" on your storm door to pull it shut. The valve remains closed as long as there is no positive pressure inside the bag. Like a storm door, the valve has no ability to open itself, grab the gas in the bag and force it to leave. If a one-way degassing valve is defective, it may get stuck open like a broken storm door flapping in the breeze, but that only allows fresh air to freely exchange between the bag and the atmosphere. A broken one-way valve cannot force gas to leave the bag against its will.

If the one-way degassing valve cannot remove gas from the bag and all other external factors have been ruled out, where is the missing gas? PBI laboratory studies reveal that there are at least two leads in the case. This is a developing answer and testing is ongoing, but we now know that one cause of missing gas/self-

vacuum-packing bags is the use of low barrier materials for coffee pouches. When coffee degasses in a bag, an imbalance of gas concentrations is created between the outside and the inside of the bag. Inside there is a high concentration of carbon dioxide, a natural by-product of roasted organic material. Outside there is atmospheric air which has a very low concentration of carbon dioxide (~ 0.03%). You can think of the materials used for coffee bags as microscopic screens with microscopically small screen mesh. A low barrier material will have bigger holes in its mesh compared to a high barrier material (see figures 1 and 2). Because of the imbalance of gas concentrations, a law of nature call partial pressures goes into effect. The design of nature causes gasses on either side of the "screens" to want to have equal concentrations. The high concentration of carbon dioxide inside the bag can see the low concentration outside and does not like being unequal. It pushes through the screen and out of the bag to equalize the concentrations. By the time the concentrations are equal, there is very little gas left inside the bag. Without much gas in the bag, the weight of the earth's atmosphere presses down on it. It becomes hard to the touch and vacuum-packs, seemingly all by itself. To solve this problem a coffee roaster can upgrade to a higher barrier bag that will have a smaller "screen mesh" to prevent gas permeation out into the atmosphere.

However, there are cases where a high barrier bag is used and gas still seems to go missing. This is where the second cause of self-vacuum-packing bags may come into play. Coffee gas is created when molecules inside a coffee bean react with oxygen in the air. Solid compounds inside the coffee bean convert to a gaseous state. The gas then flows out of the beans into the space surrounding them. This occurs for a period of days or weeks creating gas pressure in the bag. During this time a coffee bag is soft and excess gas is being released into the atmosphere through the one-way degassing valve. In some cases, after the coffee beans are finished off-gassing, they

will re-absorb some of the gas. This is the second culprit in the Mysterious Case of the Missing Gas. No gas or anything else leaves the bag to create a vacuum pack, but the coffee gas that was in the bag headspace has now turned into a solid and gone back into the coffee beans. Without gas in the headspace of the bag to balance out the pressure of the earth's atmosphere, the atmosphere pushes on the flexible bag with all of its might and presses it into a hard vacuum pack. The gas has staged its own disappearance with the coffee beans as its accomplice!

The good news of this story is that fresh coffee beans that vacuum pack themselves remain protected from the damaging effects of oxygen and will remain fresh. Perceptions sometimes rule, however, and some customers may deem a

hard package to be stale or defective. Since re-absorption of gas may be part and parcel of roasting living, breathing coffee beans, we must educate customers that a hard/vacuum packed bag is protecting their coffee as well or better than a soft one and is the result of packing very fresh, highly degassing coffee.

It is not the result of packing stale beans or using defective packaging. We will continue studying this in PBI's research laboratories and will keep our customers up to date on any developments that might allow us to predict when a coffee bag will vacuum pack and possible ways of preventing it if desired.

Figure 1. Low Barrier Open mesh, lots of Oxygen can get through.

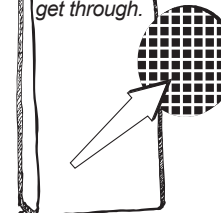
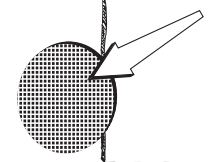


Figure 2. High Barrier Tight mesh, very little Oxygen can get through



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