

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AIR PRODUCTS AND CHEMICALS, INC.,
Petitioner

v.

EVONIK OPERATIONS GMBH and EVONIK CORPORATION,
Patent Owner.

Case IPR2024-00611

Patent 10,471,380 B2

PATENT OWNER EVONIK'S RESPONSE UNDER 37 C.F.R. § 42.120

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I. Introduction

The Priske-'380 patent relates to processes for membrane separation of gases, and in particular to specific methods with reduced maintenance costs. AP1001-Priske-'380, 1:4-6. Before the present invention, the design of gas separation systems typically focused on achieving high purity in combination with low energy consumption (i.e., lower operating costs), because energy costs were understood to “considerably determine the optimal process configuration.” AP1007-Scholz, 2. Priske-'380 recognized a “new problem”; specifically, that “some gas separation plants are operated at sites where energy is very cheap.” AP1001-Priske-'380, 1:47-49. Priske-'380 recognized that under these conditions, minimizing energy consumption alone would not result in the optimal membrane gas-separation process. Instead, Priske discovered that one could design a more efficient and profitable membrane gas-separation method that achieves both an optimal level of energy use (an “energy optimum”) and an optimal level of maintenance costs (a “maintenance cost optimum”) to achieve highly effective membrane gas-separation systems with reduced total membrane capacity in sum for all three stages of the three-stage system and thus reduced investment set-up. *Id.*, 17:41-46. In order to do so, Priske discovered, a three-stage membrane gas separation system should comprise a unique combination of features: (1) “an increase[d] total membrane capacity of the retentate separation stage compared to the total membrane capacities of the separation stage,” where “capacity” is a term defined in Priske-'380, (2) a “special” recycling rate,

and (3) “a specific quotient of pressure ratios of the permeate separation stage over the feed stream separation stage.” AP1001-Priske-’380, 2:27-40; 6:22-24.

Despite hiring a self-described “super expert,” Dr. Baker, with over 50 years of professional experience, who quarterly “look[s] at . . . every membrane patent” and spent between 10 and 20 days preparing his declaration,¹ Petitioner concedes that it could not locate any pre-existing membrane gas separation process that identified the problem and consists of this novel set of features as a solution. Instead, Petitioner asserts two grounds based solely on obviousness.

Each of those grounds is legally and factually flawed in numerous ways and at the most basic level. For Ground I, Petitioner primarily relies on U.S. Patent 8,999,038 (the “Ungerank patent”), that is **not prior art** to Priske-’380. But even if the Ungerank patent were prior art, Ground I fails to make out anything approaching a prima facie case of obviousness. Petitioner’s theory in Ground I is that a POSITA would use Comparative Example 1 in the Ungerank Patent – a “tiny” system with no commercial application – as a starting point and then look to the disfavored designs in Figures 7(a) and 7(b) of the Scholz article – a paper about maximizing profitability in commercial systems – for membrane sizing information because that information is allegedly not disclosed in

¹ EX2009-Baker Dep., 22:13-24:17. Petitioner’s “super expert,” Dr. Baker, is not and never was a POSITA under Petitioner’s own definition. By 2014 he had 30 years of experience with membrane systems for gas separation – ten times the level of a POSITA – and had designed 100-200 systems. *Id.*, 46:9-47:17.

Comparative Example 1. But not only is there no reason a POSITA would look to Comparative Example 1 as a starting point; even if he or she did so, Petitioner fails to show any reason why a POSITA would go elsewhere for membrane sizing information. Contrary to Petitioner's assertion, Comparative Example 1 states exactly what membrane modules it uses.² Ground I devolves from there into a number of additional unfounded positions that contradict the record evidence and the law.

Ground II is a single-reference obviousness theory based on Figure 7 of the Scholz article alone. As Petitioner must concede, Figure 7 does not disclose any embodiment that meets claim limitation 1.f.i, which requires a recycle volume between 60 and 100% – and it doesn't even come close. Instead, Petitioner's theory is that because Scholz discloses two separate embodiments (Figure 7(a) and Figure 7(b)) that are each way off the claimed recycle range in opposite directions (one at 51.5% and the other at 135%), designing a process that had a recycle volume within the claimed range is *prima facie* obvious. Petitioner's theory badly misinterprets the Federal Circuit precedent on which it relies and finds no factual support in the record evidence. Indeed, when asked, Dr. Baker readily conceded that his opinion was not that a POSITA looking at Scholz Figure 7 *would* have been motivated to design with the recycle volume of the claimed process,

² Dr. Baker was simply unfamiliar with the membrane modules described in Comparative Example 1. EX2009-Baker Dep., 86:9-87:22.

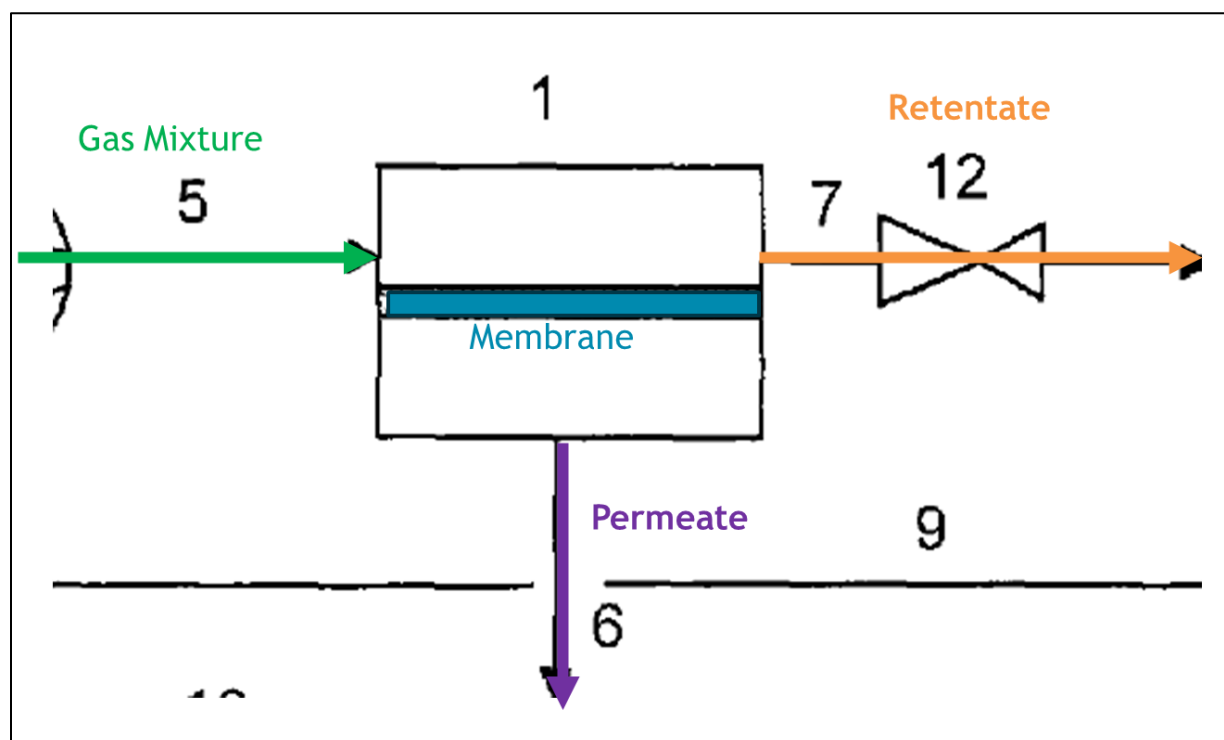
but only that, based on the Priske-'380 claim language she or he *could* get to the claimed ratios if instructed to do so. This is exactly the type of hindsight analysis that is prohibited.

The Board should affirm the patentability of all Challenged Claims.

II. Technical Background

The invention of Priske-'380 relates to specific processes and an apparatus for separation of gas mixtures. Methods for separation of mixtures of gases into relatively pure streams of the mixture's component gases (e.g., "gas separation") can serve various commercial purposes. For example, gas separation technology can be applied to biogas streams—comprising methane (CH₄) and carbon dioxide (CO₂)—to separate the CH₄ and/or CO₂ from the biogas stream. EX2008-Geise Decl., ¶18.

In membrane gas separation, as a gas is introduced to a membrane system, the membrane dissolves the gas and diffuses it to the other side of the membrane. Some gases pass more quickly through the membrane while others more slowly. Thus, the gas mixture that passes through the membrane (the "permeate") and the gas mixture that does not pass through the membrane (the "retentate") end up relatively richer in different constituent gases.



Gas separations can involve one, two, three, or more stages to separate a gas mixture into one or more pure (or relatively pure) gas streams. The effectiveness of a membrane gas-separation system depends on the specific structure of the system (e.g., number of stages, how they are connected, number of compressors, use of pressure reducing valves) and the process conditions used (e.g., pressure, temperature, membrane composition and size). EX2008-Geise Decl., ¶19-20.

The performance characteristics of a membrane gas-separation system depend on numerous process parameters, including:

- **Selectivity.** A membrane's *selectivity* is a measure of its preference for permeating one gas relative to another gas. A high selectivity membrane may be more effective at separating one gas from another, but that

generally comes at the cost of decreased permeability, increased energy consumption, and higher cost membranes. EX2008-Geise Decl., ¶22; EX2011-Matteucci, 4; EX2012-Robeson, Fig. 2.

- **Permeance.** *Permeance* is a measure of how effectively a certain gas can move through a membrane under a given set of conditions (e.g., temperature and pressure).³ Permeance can affect the overall efficiency and throughput of a gas separation process, as higher permeance allows for a greater degree of separation, but may compromise selectivity. EX2008-Geise Decl., ¶23.
- **Membrane Composition:** The *chemical composition*, physical structure and thickness of a membrane can affect its permeance, selectivity and cost. For example, a membrane made of dense polymers typically offers high selectivity but lower permeability, while a relatively porous membrane may provide higher permeance at the expense of selectivity. EX2008-Geise Decl., ¶24; EX2011, Matteucci2006.
- **Pressure Ratio.** The *pressure ratio* for a membrane separation indicates the difference in pressure between the feed side (where gas is introduced)

³ Permeance is specifically defined in the specification of Priske-'380 and is discussed in more detail in Section III.1 below.

and the permeate side of the membrane. The feed side necessarily has a higher pressure than the permeate side, and this difference in pressure causes gas to permeate from the feed side to the permeate side. As the pressure ratio increases, more gas overall permeates through the membrane and is separated from the feed stream. EX2008-Geise Decl., ¶25.

- **Recycle Volume.** The *recycle volume* refers to the amount of gas reintroduced into the feed stream for further separation after the gas has gone through an initial separation process. Recycling of gas streams generally achieves a higher overall purity of a separated gas at the expense of increased energy costs. EX2008-Geise Decl., ¶26.

EX2008-Geise Decl., ¶21-26. These variables are highly interdependent and often unpredictable. For example, increasing the capacity of a membrane will affect the pressure ratio over the membrane as more gas passes through the membrane. EX2008-Geise Decl., ¶27. Changing the pressure ratio over a separation stage will change the amount of gas passing through the membrane, and thus will necessarily change the recycle volume of the process. EX2008-Geise Decl., ¶27. Similarly, changing the recycle volume of a process will change the capacity required in a process. EX2008-Geise Decl., ¶27. Therefore, alteration of even one of the process variables can have unexpected effects on

other process variables, and great care must be taken in making such alterations. EX2008-Geise Decl., ¶27.

In some cases, modeling software can assist a POSITA in designing a membrane gas-separation system. However, an effective model must not only accurately represent design constraints and logistical challenges, but also include sufficient information and assumptions to ensure its practical applicability. Any separation process designed using a model must be validated or tested to confirm its effectiveness in real-world conditions. EX2008-Geise Decl., ¶28-29.

III. U.S. 10,471,380 (Priske-'380)

A. Background

Priske-'380, entitled “Process for Separation of Gases with Reduced Maintenance Costs”, issued November 12, 2019, and names Markus Priske as the sole inventor. The technology disclosed in Priske-'380 “relates to a specific process and apparatus for separation of gas mixtures with reduced maintenance costs.” AP1001-Priske-'380, 1:4-6. Previously, it was “generally known that gas mixtures can be separated by means of gas separation membranes because of different permeabilities of the individual gases.” *Id.*, 1:7-10. Membrane gas-separation systems known in the art were generally “optimized in view of product purity in combination with the lowest energy

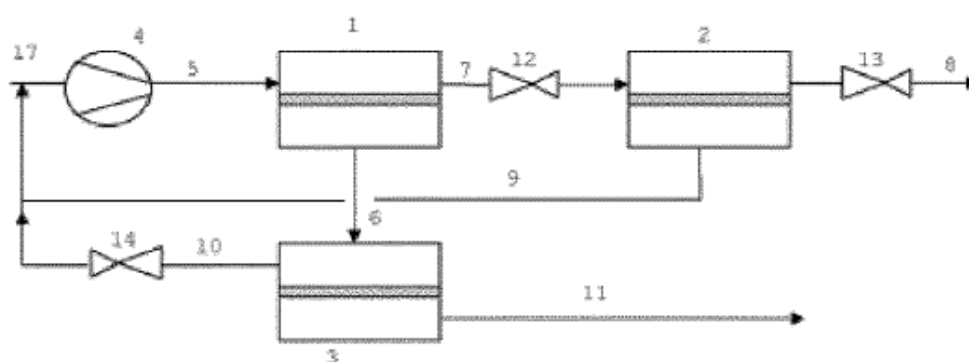
consumption.” *Id.*, 1:40-42. Such “processes provide two high pure product streams in an **energy optimized way**.” *Id.*, 1:42-44.⁴ EX2008-Geise Decl., ¶30-31.

The inventor recognized a new problem unaddressed by prior art separation systems—namely that “some gas separation plants are operated at sites where energy is very cheap’ such that “[a]t such locations the focus of the operators of separation plants lies on **investment and maintenance costs rather than on an energy saving**.” *Id.*, 1:49-51. Disclosed and claimed in the Priske-’380 are inventive methods for separation of gas mixtures that achieve high purity in both the permeate and retentate gas that have advantageous operation and maintenance costs. Applying the inventive methods, high purity products can be obtained with membranes having a wide range of selectivities. When compared to the prior art processes, *e.g.*, WO 2012/000727 (a PCT application from which the Ungerank patent originates that is discussed extensively throughout Priske-’380) (“Ungerank PCT application”), the invention of Priske-’380 allows “reduce[d] ... membrane capacities, required in sum for all [three] separation stages in the process.” AP1001-Priske-’380, 5:65-6:1. “Thus, the investment costs and in particular the maintenance costs can be reduced significantly.” *Id.*, 6:1-3. EX2008-Geise Decl., ¶30-31.

B. Detailed Description

⁴ Emphases added unless otherwise stated.

The specification of Priske-'380 discloses a three-stage membrane gas-separation system that optimizes maintenance costs where energy costs are low. *Id.*, 2:27-30. An “illustrative connection arrangement” depicting the design of the claimed three-stage process is depicted in Figure 1:



Illustrative connection arrangement of several membrane modules according to invention

Priske surprisingly found that the inventive process and apparatus “can afford pure streams of permeate and retentate without requiring more than one compressor ... without further purification of the permeate or retentate stream by other methods” and with a “significantly reduced overall membrane capacity” to achieve streams in high purity. AP1001-Priske-'380, 2:13-26. He further surprisingly found that, using the inventive process, “a maintenance cost optimum for three-stage membrane separation” could be achieved. *Id.*, 2:27-30. Using the three-stage system, the inventive process accomplishes these results by employing three features: 1) use of “special” recycle rates that result in

“increasing the total gas volume recycled in sum with the second permeate stream and the third retentate stream”, 2) “increas[ing] of the total membrane capacity of the retentate separation stage compared to the total membrane capacities of separation stage”, and 3) using “a specific quotient of the pressure ratios of the permeate separation stage over the feed stage separation stage.” *Id.*, 2:30-40; 6:22-24. EX2008-Geise Decl., ¶32.

The specification provides twelve examples (Examples 1-12). Each example includes a “Reference Example” to which the inventive features of Priske-’380 are compared to highlight the benefits of the inventive features. Reference Examples 1-3 are examples reproduced from the Ungerank PCT application. EX2008-Geise Decl., ¶33.

For example, Reference Example 1 of Priske-’380 is a reproduction of Comparative Example 1 from the Ungerank PCT application. *Id.*, 16:28-40. Example 1.1 of Priske-’380 teaches that by increasing the “membrane capacity” of the retentate separation stage and the “quotient of the pressure ratios of separation stage (3) over separation stage (1)” (in a manner that embodies the claimed invention) resulted in a “total membrane capacity, in sum for all three separation stages” that was “14.9% lower than in Reference Example 1.” *Id.*, 16:42-17:46. “In other words, in the inventive set-up of the apparatus . . . could be reduced because the required total membrane capacity could be reduced.” *Id.*, 17:37-46. EX2008-Geise Decl., ¶35.

Reference Example 2 is a reproduction of Example 1 from the Ungerank PCT application. *Id.*, 8-19. Example 2 alters the conditions in Reference Example 2 by

increasing the recycling rate to 71%, increasing the membrane capacity at the retentate stage, and increasing the quotient of pressure ratios. Example 2 is an embodiment of the claimed invention. “Due to the inventive modifications, the total membrane capacity required in Example 2 [the sum of the total membrane capacity at all three stages] could be reduced, compared to Reference Example 2, by 15 percent.” *Id.*, 19:60-62. EX2008-Geise Decl., ¶36.

Reference Example 3 is a reproduction of Example 3 of the Ungerank PCT application. *Id.*, 20:7-19. Example 3 alters Reference Example 3 by increasing the recycle rate to 77%, increasing the membrane capacity at the retentate stage, and increasing the quotient of pressure ratios. *Id.*, 20:23-26. As a result of these “inventive modifications a saving of 8% of the total membrane capacity” compared to the reference example was achieved. *Id.*, 21:6-10. EX2008-Geise Decl., ¶37.

Examples 4-10 also compare the inventive features of the Priske-'380 claims with different and varied other comparative examples and show “that [the] process and apparatus of the invention are applicable for a wide range of operating pressures, membrane selectivities and for different gas mixtures.” *Id.*, 27:64-28:58. EX2008-Geise Decl., ¶38.

In all cases, “the inventive combination of ‘recycling rates’, ‘increased membrane capacity in stage (2)’ and ‘quotient of pressure ratio of stage (3) over pressure ratio of stage (1),’ in all cases led to a saving of overall membrane capacity compared to the

corresponding comparative examples” and that “[a] saving in total membrane capacity correlates to savings in invest and maintenance costs and is very lucrative for applications in regions where energy is cheap and invest respectively maintenance costs are decisive.” *Id.*, 28:1-57. EX2008-Geise Decl., ¶38.

In Examples 11 and 12, use of membranes with different selectivities at different separation stages (Example 11) were compared with use of membranes with identical selectivities at all three stages (Example 12). *Id.*, 28:61-65. Comparison of Example 11 and Example 12 revealed that the inventive process and apparatus is successfully employed with membranes with different selectivities in different separation stages as well as with membranes with identical selectivities in all separation stages. EX2008-Geise Decl., ¶39.

C. Claims

Independent claim 1 of the Priske-’380, the sole independent claim, recites specific values for three key features of the claimed method:

- (i) the combined gas volume of the second permeate stream and the third retentate stream is from 60 to 100% of the volume of the crude gas stream;
- (ii) the total capacity of the gas separation membranes in the retentate separation stage is higher than the total capacity of the gas separation membranes in the feed stream separation stage, the total capacity being measured for nitrogen Grade 4.8 under standard conditions as defined in the description; and

(iii) the quotient of the pressure ratio over the permeate separation stage to the pressure ratio over the feed stream separation stage is in a range of from 0.5 to 8;

Id., cl. 1.f.i–iii.

Dependent claims at issue claim apparatus configurations in the process (compressor, vacuum device, pressure reducing valve) (dependent claim 17), the ratio of the membrane capacity in the retentate separation stage to the feed stream separation stage (dependent claims 8), the range of selectivity membrane for CO₂/CH₄ range of (dependent claims 12), the volume of the recycled gas (dependent claim 9), and the pressure ratio of the permeate separation stage and the feed separation stage (dependent claim 10).

IV. Asserted References

A. The Ungerank Patent (U.S. 8,999,038)

The Ungerank patent issued on April 7, 2015, and thus has an effective date for the purposes of determining whether the patent qualifies as prior art 35 U.S.C. §102(a)(1) of the America Invents Act as of that date. 35 U.S.C. §102(a)(1); MPEP §2152.02(a) (“The effective date of the patent for the purposes of determining whether the patent qualifies as prior art under AIA 35 U.S.C. §102(a)(1) is the grant date of the patent.”). The Ungerank patent shares a common inventor with Priske-’380, Markus Priske. As of the priority date of Priske-’380, December 29, 2014, both the application for the Ungerank patent and the

application for Priske-'380 were assigned to Evonik Fibres GmbH.⁵ The Ungerank PCT application, to which the Ungerank patent claims priority, was considered and cited by the Examiner of the Priske-'380 application – who was also the Examiner assigned to the Ungerank prosecution – and is listed on the face of Priske-'380. Comparative Example 1, Example 1, and Example 3 of the Ungerank PCT application are discussed throughout Priske-'380 and compared against the “inventive teachings” of Priske-'380. EX2008-Geise Decl., ¶42.

The Ungerank patent teaches one-stage, two-stage, and three-stage processes for the separation of gas mixtures through membranes. AP1006-Ungerank patent, Figs. 1-11. The Ungerank patent teaches that “[m]embranes of higher selectivity have the advantage that the separation becomes more effective and less permeate has to be recycled from retentate separation stage (2), or less retentate from permeate separation stage (3).” AP1006-Ungerank patent, 9:14-17. The Ungerank patent teaches that using the inventive apparatus enables “pure streams of permeate and retentate without requiring more than one compressor,” and low capital costs. “The inventive operation can be conducted in a much more economically viable manner with more selective membranes, and the necessary size of the compressor and the energy required can be reduced.” AP1006-Ungerank patent, 3:31-41; 9:30-34. EX2008-Geise Decl., ¶43-44.

⁵ Both the Ungerank patent and Priske-'380 were assigned from Evonik Fibres GMBH to Evonik Operations GMBH on September 20, 2022.

The Ungerank patent provides five examples, labeled “Comparative Example 1” and “Examples” 1-4. The Ungerank patent teaches that using membranes with higher selectivity than those of Comparative Example 1 “enables a more economically favorable process” by allowing for “a lower recompression.” *Id.*, 11:49-52. In other words, the Ungerank patent states that using higher selectivity membranes will be more economical than using the membranes in Comparative Example 1. The Ungerank patent further teaches that “[i]n order to satisfy various legislators, it is necessary to minimize the methane loss into the atmosphere.” *Id.*, 11:52-63. Examples 2-4 teach gas separation processes “with a methane content in the permeate stream of less than 0.5%.” *Id.*, 11:54-14:43. By contrast, Comparative Example 1 and Example 1 demonstrate levels of methane content in the permeate stream that is greater than 0.5%. *Id.*, 10:57-58, 11:41-42. EX2008-Geise Decl., ¶45-47.

Comparative Example 1 is the sole embodiment of the Ungerank patent discussed in the grounds presented in the Corrected Petition. As Dr. Baker notes, Comparative Example 1 involves a crude gas stream with a flow rate of only 1.78 m³/h (*id.*, 10:16-28) indicating that Comparative Example 1 would have been a “tiny” system, rather than a scaled up commercial system. EX2009-Baker Dep., 127:10-11. Comparative Example 1 utilizes a three-stage membrane gas separation system where “[e]ach stage consisted of a hollow fiber membrane module consisting of hollow polyimide fibers from UBE (NM B01 A type). AP1006-10:25-27. According to the Ungerank patent, those membrane modules

exhibit a “moderate” (not “low”) mixed gas selectivity for carbon dioxide over methane of 20 and exhibit equal surface area. *Id.*, 10:66-67. EX2008-Geise Decl., ¶84.

B. Scholz

Scholz is a journal article titled “Structural optimization of membrane-based biogas upgrading processes” published in the Journal of Membrane Science in 2015. The document states that it was available online as of September 28, 2014. AP1007-Scholz. Scholz teaches a “structural optimization approach to biogas upgrading processes” that uses a process modeling system. *Id.*, Abstract. Scholz applies this “structural optimization approach to identify the most profitable membrane-based biogas upgrading system” for certain commercial and custom membrane types. *Id.*, 2. In each of these models, certain assumptions about the economic costs and other conditions are kept constant, whereas other parameters are modified for evaluation. For example, Table 3 of Scholz shows the economic assumptions used in its modeling:

Table 3

Economic parameters used for optimization of a membrane based biogas upgrading plant.

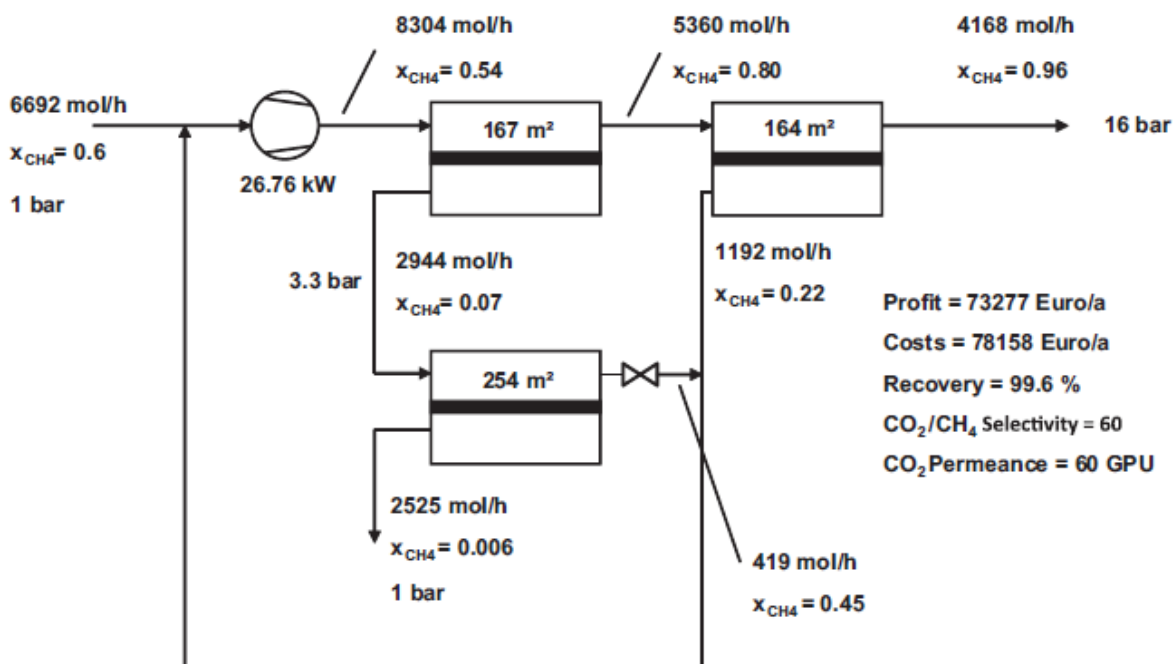
Costs	Unit	Value
Membrane module costs	$\frac{\text{Euro}}{\text{m}^2}$	55
Electrical costs	$\frac{\text{Euro}}{\text{kWh}}$	0.08
Commission of purified gas	$\frac{\text{Euro}}{\text{m}^3}$	0.2
Membrane lifetime	year	4
Annual operation	h	8,000
Interest rate	–	0.09
Amortization period	years	8

Scholz states that “operational cost” is “mainly caused by electrical energy consumption”; Scholtz does not contemplate a circumstance in which that is not the case. *Id.*, 4. Instead, Scholz keeps the cost of electricity constant at 0.08 Euro/kWh in each application of its model. *Id.* While Scholz discloses certain economic assumptions and process parameters, Scholz does not disclose the details of the method used to calculate a process’s profit; put differently, a POSITA would not be able to determine how changing any particular input to Scholz’s model would affect the output.⁶ EX2008-Geise Decl., ¶48-51.

Scholz describes the implementation of his model under at least five different sets of circumstances. Figure 5 shows what Scholz’s model recommends as the optimal

⁶ Part of Scholz’s analysis is based on General Algebraic Modeling Systems (GAMS). AP1007-Scholz, Abstract. Dr. Baker has never used GAMS and is not familiar with what it is and how it works. EX2009-Baker Dep., 49:6-7; 62:8-16.

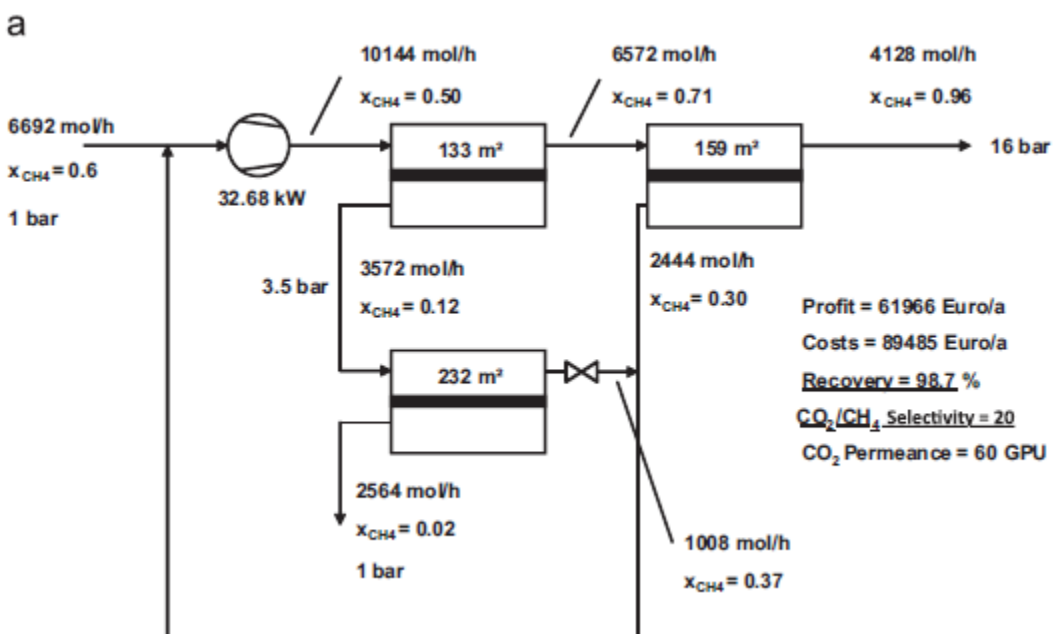
process layout together with the process parameters for a membrane material with a CO_2/CH_4 selectivity of 60 and a CO_2 permeance of 60 GPU:



In its sole reference to the Ungerank PCT Application, Scholz states that “a membrane CO_2/CH_4 selectivity of 60 was assumed . . . for a polyimide membrane material” based on the Ungerank PCT Application. *Id.*, 2. EX2008-Geise Decl., ¶¶52-54.

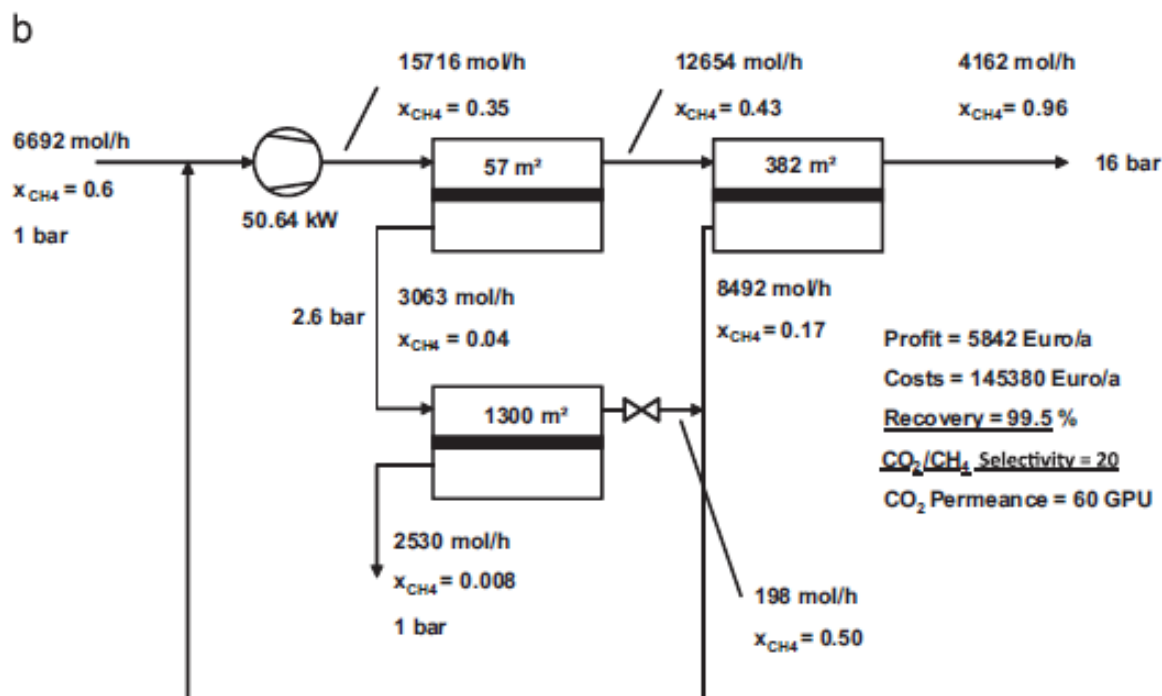
Figure 7 depicts the output from the Scholz model in two configurations using a cellulose acetate membrane with a CO_2/CH_4 selectivity of 20 unidentified as to mixed or pure gas. Figure 7(a) Scholz allowed the methane recovery to be optimized between 95% and (at least) near 100%, thus, allowing the solver to find the optimum balance between investment for membranes, compression equipment, operating costs (energy demand) and

revenue generated by a maximization of methane sales (methane recovery). Figure 7(a) reflects the output where the lower bound for methane recovery is set to 95 percent:



EX2008-Geise Decl., ¶55-57.

Scholz further investigated the impact on profit if the process with the maximum profit for cellulose acetate membranes having a selectivity of 20, is modified to a fixed target value for recovery of 99.5%. Figure 7(b) provides the results of the Scholz model where the methane recovery is fixed at an ecologically acceptable 99.5 percent and demonstrates that the profit significantly decreases when the recovery is fixed instead of optimized as a variable as in Figure 7(a). That is while both the results of Figures 7(a) and 7(b) are obtained by applying different boundary conditions, Figure 7(a) was generated using recovery as a variable, while Figure 7(b) shows the results when recovery is fixed and not used as a variable.



EX2008-Geise Decl., ¶58.

Scholz further points out that the lower levels of methane recovery possible in the Figure 7(a) model would have a detrimental impact on the environment. AP1007-Scholz, 6 (“For the processes considered here, the CH₄ recovery should be at least 99.5% to minimize the environmental impact caused by extensive CH₄ losses.”). EX2008-Geise Decl., ¶59.

V. Level Of Ordinary Skill In The Art

For the purposes of this Patent Owner Response, Patent Owner utilizes Petitioner’s proposed level of skill in the art: an individual with “a Master of Science degree in physical chemistry, chemistry, chemical engineering, or a related field, and at least three

years of work experience in membrane gas-separation systems, including but not limited to biogas membrane separations.” Cor.Pet., 11; *see also* AP1003-Baker Decl., ¶¶56–60.

VI. Claim Construction

Two claim terms require construction in this IPR: membrane “capacity” and “standard conditions as defined in the description.” “Capacity” is defined in Priske-’380. Cor.Pet., 10, 20, EX2009-Baker Dep., 81:24-82:20. Thus, under *Phillips*, it must be given a claim construction and cannot be interpreted as “plain meaning.” *Phillips v. AWH Corp.*, 415 F.3d 1303, 1316 (Fed. Cir. 2005) (“[T]he specification may reveal a special definition given to a claim term by the patentee that differs from the meaning it would otherwise possess. In such cases, the inventor’s lexicography governs.”). Priske-’380 defines membrane “capacity” as “the product of the membrane surface and the permeance of the membrane at operating temperature that is determined for nitrogen (grade 4.8) under standard conditions.” AP1001-Priske-’380, 2:53-57. EX2008-Geise Decl., ¶66. The Board should construe “capacity” (of the membrane) in accordance with this definition in the specification. *Phillips*, 415 F.3d at 1316.⁷

Claim element 1.f.ii also requires measurement “under standard conditions as defined in the description.” Again, because this term does not have a “plain meaning” and is expressly defined in the specification, under *Phillips* it must be given a claim

⁷ The Baker reference does not identify what its “standard conditions” are, let alone identify the ones described in Priske.

construction. This term should be construed to mean “the conditions as set forth at column 14, line 51 through column 15, line 23” of Priske-’380. *Phillips*, 415 F.3d at 1316. EX2008-Geise Decl., ¶66.

VII. Argument

A. Ground I: Claims 1-5, 7, 9 And 11-23 Would Not Have Been Obvious Over The Ungerank Patent In View Of Scholz

Ground I is fundamentally flawed and fails to show a *prima facie* case of obviousness for numerous reasons. **First**, the primary reference, the Ungerank patent, is not prior art and thus cannot properly form the basis for any obviousness challenge. **Second**, the Petition fails to demonstrate that Scholz teaches claim element 1.f.ii under the correct claim constructions. **Third**, contrary to the premise of Petitioner’s motivation to combine assertions, the Challenged Claims are not directed to filling a need in the art for “lower-selectivity” membranes nor was there a need in the art for such systems. **Fourth**, Petitioner points to nothing in the Ungerank patent that would motivate a person of skill in the art to start with it rather than another membrane gas separation system using membranes with similar selectivity. **Fifth**, even if a POSITA did elect to start with Comparative Example 1 in the Ungerank patent, the Petition wholly fails to identify any reason a POSITA would have looked to modify that system using the membranes described in Scholz. Indeed, the only reason the Petition identifies for looking outside of Comparative Example 1 – that “Ungerank’s Comparative Example 1 does not provide details on the membranes’ areas or their ratios) – is plainly wrong. **Sixth**, the Petition

fails to demonstrate that a POSITA would have had a reasonable expectation of success in combining the membrane areas of Scholz with Comparative Example 1. **Finally**, for dependent claims 9, 12 and 17, there are additional reasons Ground I fails.

1. The Ungerank Patent Is Not Prior Art

Petitioner elected to file the original petition on February 23, 2024 – the very last day on which it could file a petition for IPR under 35 U.S.C. §315(b) before the one-year bar prohibited it. IPR2024-00611-2 (Original petition as filed). Petitioner asserted the Ungerank patent, rather than the patent application publication, as the basis for its challenge. Pet., 2, 17-42.

In a “Corrected” Petition filed long after the statutory bar date, Petitioner asserts that the Ungerank patent is prior art under Section 102(a)(1). Cor.Pet., 3.⁸ That is incorrect. Under Section 102(a)(1), the Ungerank patent is not prior art to Priske-’380 because it issued after the application for Priske-’380 was filed. 35 U.S.C. §102(a)(1); MPEP §2152.02(a) (“The effective date of the patent for the purposes of determining whether the patent qualifies as prior art under AIA 35 U.S.C. §102(a)(1) is the grant date of the patent.”). The effective date of the Ungerank patent, AP1003, is April 7, 2015 –

⁸ The original Petition asserted that the Ungerank patent is prior art under 35 U.S.C. §102(a)(2). See Petition, 3. That is also incorrect, because the subject matter disclosed (in the Ungerank patent) and the claimed invention (Priske-’380) were owned by the same person, Evonik Fibres GmbH.

the date on which the Ungerank patent issued. Because the Ungerank patent is not prior art to Priske-'380, Ground I fails.

Seeking to avoid this statutorily mandated outcome, in the corrected petition, Petitioner attaches as an exhibit a *different* reference – U.S. Patent App. Pub. No. 2013/0098242 (the “Ungerank ’242 application”). Cor.Pet., 3. Petitioner then states that the Ungerank patent – *not* the Ungerank ’242 application – is prior art under § 102(a)(1) because portions of its text were published in the Ungerank ’242 application.⁹ That is incorrect. There is no statutory or other basis to conclude that – simply by making reference to the content of a different document (AP1038) – the effective date of AP1003 is changed. Indeed, the statute and the MPEP are both clear that it is not. *See* 35 U.S.C. §102(d) (specifying the effective date earlier than the date of patent issuance under Section 102(a)(2), but not under Section 102(a)(1)); MPEP §2152.02(a)).

The Board is confined to the actual grounds set forth in the petition. *Koninklijke Philips N.V. v. Google LLC*, 948 F.3d 1330, 1336 (Fed. Cir. 2020) (The petition, not the Board’s “discretion,” defines the metes and bounds of an inter partes review.). Ground I must be rejected in full because the Ungerank patent is not prior art to Priske-'380.

2. Petitioner Has Not Demonstrated That Scholz Teaches Limitation 1.F.Ii

⁹ Dr. Baker did not find the Ungerank ’242 application relevant to his opinions, and it is not on his list of materials considered. EX2009-Baker Dep., 44:13-45:18.

The Corrected Petition relies solely on Figure 7 of Scholz for limitation 1.f.ii. Cor.Pet., 29-31; EX2009-Baker Dep., 111:22-25. But limitation 1.f.ii requires that “the total **capacity** of the gas separation membranes in the retentate separation stage is higher than the total capacity of the gas separation membranes in the feed stream separation stage, the total capacity being measured for **nitrogen Grade 4.8 under standard conditions as defined in the description.**” Petitioner has failed to meet its burden to show that Scholz discloses these limitations as properly construed. EX2008-Geise Decl., ¶67-71.

Rather than apply the correct construction of “capacity” to the analysis of Figure 7 of Scholz, Petitioner and Dr. Baker simply assumed that “capacity” means “the equivalent of membrane area.” EX2009-Baker Dep., 82:22-83:13. (“Q. And that’s the understanding of capacity that you applied in rendering your opinions; is that correct? A. Yes.”). As stated above, the “capacity” is defined in Priske-’380 as “the product of the membrane surface and the permeance of the membrane at operating temperature that is determined for nitrogen (Grade 4.8) under standard conditions.” AP1001-Priske-’380, 2:53-57. Neither the Petition nor Dr. Baker analyzed the membranes in Scholz applying that claim construction. Indeed, Petitioner and Dr. Baker fail to establish the permeance of *any membrane* in Scholz at operating temperature for nitrogen (Grade 4.8). EX2008-Geise Decl., ¶68. Petitioner has failed to meet its burden to demonstrate that Scholz teaches this element of claim 1.

Moreover, claim element 1.f.ii further requires that capacity be measured “for nitrogen Grade 4.8 under standard conditions as defined in the description.” That definition is provided at column 14 line 51 through column 15 line 23. Petitioner and Dr. Baker also fail to analyze Scholz Figure 7 applying this construction, which would have necessitated demonstrating that Scholz either expressly or inherently disclosed that each of its membranes would have capacity that is “proportional” (EX2009-Baker Dep., 83:2) to surface area if tested (1) using grade 4.8 nitrogen, (2) “at the average operating temperature of the membrane,” AP1001-Priske-’380 14:65-66, (3) at a retentate pressure of 11 bar, (*id.*, 15:1), (4) a permeate pressure of 1.1 bar, *id.*, 15:2, and (5) that “the surface (HFM) correlates to the external membrane surface as defined in the definitions section”, *id.*, 15:3-5. Petitioner’s argument that “it would have been obvious to a POSITA to measure permeances at standard conditions” (Cor.Pet., 30) is inapposite here—because it fails to show that *Scholz teaches any particular permeance or total capacity for Grade 4.8 nitrogen under the “standard conditions” defined by the specification.* For Petitioner’s argument to succeed, it is not enough that using standard conditions be obvious—Scholz must teach the claimed capacity values at the specific standard conditions described in the patent. It does not. EX2008-Geise Decl., ¶68.

Petitioner’s circular argument—that identical CO_2 permeances must mean the ratio of membrane capacities correlate to the ratio of membrane surface areas, and thus the ratio of membrane surface capacities *measured under nitrogen (Grade 4.8)* must correlate to

the ratio of membrane surface areas (Cor.Pet., 30)—is unsupported. While it is true that under circumstances where the materials are identical, they may have identical permeances and thus relative total capacity may be proportional to membrane surface area (AP1001-Priske-'380), such an assumption requires that the membranes be in fact **identical**, not only in chemical composition, but also in other factors including thickness and manufacturing processes and treatments. These assumptions are not taught by Scholz. Permeances of the different elements CO₂ and nitrogen may vary for any given membrane. EX2008-Geise Decl., ¶69. Even where two membranes are comprised of cellulose acetate and have a permeance for CO₂ of 60, the permeance for nitrogen (Grade 4.8) may not be identical between the two membranes. EX2008-Geise Decl., ¶70. Permeance can vary significantly depending on chemical composition of the membrane, the size of the molecule, the thickness of the membrane—even the membrane manufacturing process or manufacturer can affect the membrane's permeability for one type of molecule versus another. EX2008-Geise Decl., ¶70. Simply saying each membrane was comprised of cellulose acetate and had a permeance for CO₂ of 60 is insufficient to establish that the claim limitation regarding the membrane capacity “measured for nitrogen Grade 4.8 under standard conditions” is met.

For these reasons, Petitioner has failed to show that Scholz teaches limitation 1.f.ii of Priske-'380.

3. Petitioner Has Not Established Any Problem Or Design Pressures That Would Have Led To The Claimed Solution

Even if the combination of Comparative Example 1 and Figure 7 of Scholz taught all claim limitations (which they do not), Petitioner fails to identify any problem known in the art at the priority date of Priske-'380 that would have led a POSITA to the claimed invention. Instead, Petitioner mischaracterizes the problem identified in Priske-'380 as a general understanding of “trade-offs” between “energy and membrane costs” related to “building and operating membrane-separation systems.” This is not the problem identified by Priske-'380, and is also not a problem that would have led a POSITA to the *invention as claimed*. Petitioner's failure to identify “a design need or market pressure to solve a problem” is fatal to Ground I. *KSR Int. 'l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007).

The underlying premise of the petition is that it would have been obvious to a POSITA in 2014 to design a system that meets the specific requirements of the challenged claims because of a “need for systems with lower-selectivity, lower-cost membranes.” Cor.Pet., 19-20. But that's neither the problem that Priske-'380 solves nor what the prior art relied upon in the grounds discloses or solves. EX2008-Geise Decl.,72.

The claimed inventions in Priske-'380 are not directed to that allegedly known problem. Rather, they solve a “new” problem in gas separation:

In recent times . . . a new problem has occurred that is not solved in a sufficient manner by the apparatuses and processes of the prior art.

The problem is that some gas separation plants are operated at sites where energy is very cheap. At such locations the focus of operators of separation plants lies on investment and maintenance costs rather than on an energy saving.

AP1001-Priske-'380, 1:45-52; EX2008-Geise Decl.,73.

Neither Petitioner nor Dr. Baker point to *any prior art reference* that recognizes that problem, let alone teaches *how* a person of skill in the art might modify a gas separation system in such circumstances. On cross-examination, Dr. Baker **admitted** that the sole piece of evidence the Petition relies upon to suggest that this problem had previously been recognized (Cor.Pet., 20-21; AP1003-Baker Decl., ¶125) – a single passage in a textbook Dr. Baker wrote – does not speak to the cost of energy at all. EX2009-Baker Dep., 164:4-7. EX2008-Geise Decl., ¶74.

As importantly, neither of Petitioner's selected references, the Ungerank patent or Scholz, say anything about how to design a membrane gas separation system where the price of electricity is low. Scholz does not discuss or imply that gas separation systems should be constructed differently when energy costs are low due to any sort of "tradeoffs between lower-selectivity and higher-selectivity membranes." Cor.Pet., 20. Instead, Scholz teaches that "higher selectivity" membranes result in "higher investment costs and membrane replacement costs" that "reduce the profitability of the upgrading process," but nonetheless that the use of higher selectivity membranes produces the highest profits and the lowest costs. AP1007-Scholz, 4. EX2008-Geise Decl.,75-77.

Further, Scholz does not model processes based on scenarios with lower energy cost; or even contemplate the possibility of lower energy costs. The Scholz model used to generate the process layouts of Figures 5, 7(a), 7(b), 8(a) and 8(b) assumed a *fixed* energy cost.

Table 3 Economic parameters used for optimization of a membrane based biogas upgrading plant.		
Costs	Unit	Value
Membrane module costs	$\frac{\text{Euro}}{\text{m}^2}$	55
Electrical costs	$\frac{\text{Euro}}{\text{kWh}}$	0.08
Commission of purified gas	$\frac{\text{Euro}}{\text{m}^3}$	0.2
Membrane lifetime	year	4
Annual operation	h	8,000
Interest rate	–	0.09
Amortization period	years	8

AP1007-Scholz, 4. According to Scholz, “operational cost” is “mainly caused by electrical energy consumption.” *Id.* In other words, Scholz *assumes that energy costs will be high* and thus a limiting factor in designing a gas separation system—this is the *opposite* of the impetus for the invention in Priske-’380. EX2008-Geise Decl., ¶75.

Petitioner’s argument similarly mischaracterizes the teachings of the Ungerank patent. The Ungerank patent says nothing about trade-offs between “energy and membrane costs” or that these are even the “most significant trade-offs” as Petitioner suggests. Cor.Pet., 19-20. The Ungerank patent universally advocates higher selectivity

membranes over lower selectivity membranes, stating that the former allow gas separation to “be conducted in a more economically viable manner,” because “the necessary size of the compressor and the energy required can be reduced.” AP1006-Ungerank patent, 9:30-34. EX2008-Geise Decl.,72.

Without any recognition of the problem actually addressed by Priske-’380 (i.e., the need for a system optimized for low energy costs), Petitioner’s Ground I must fail. *See Forest Laboratories, LLC v. Sigmapharm Laboratories, LLC*, 817 F.3d 928 (Fed. Cir. 2019) (“[W]here a problem was not known in the art, the solution to that problem may not be obvious, because ordinary artisans would not have thought to try at all because they would not have recognized the problem.”); *see also Virteck Vision Int’l ULC v. Assembly Guidance Systems, Inc.*, 97 F.4th 882 (Fed. Cir. 2024) (substantial evidence did not support finding that prior art references provided motivation to combine where there was “no evidence of a design need or market pressure”).

Even on its own terms, Petitioner’s assertion that in 2014 there was a market “need” for “lower-selectivity, lower-cost membranes” in 2014 or that the Ungerank patent or Scholz disclose “lower-selectivity, lower-cost membranes” is wrong and was repeatedly refuted by Dr. Baker. *See* EX2009-Baker Dep., 67:8-72:5. Rather than support Petitioner’s position that there was a “need” for systems that used membranes with “low selectivity” of around 20 (like those in the asserted prior art examples relied upon by Petitioner), ***Dr. Baker testified that such membranes were the industry standard at that***

time and ones that he regularly used in the systems he designed. *Id.*, 67:19-25; 71:25-72:5. EX2008-Geise Decl., ¶75-77.

Regardless, a general need for lower selectivity, lower cost membranes – even if it existed – would also not have been a specific enough “design constraint or commercial pressure” to have motivated a POSITA to combine the teachings of the Ungerank patent with those of Scholz in the manner claimed by Priske-’380. Neither the Ungerank patent nor Scholz provides any teaching or motivation of lower-selectivity, lower-cost membranes. Instead, both teach against use of such membranes because of the need for increased energy and resulting higher cost. EX2008-Geise Decl., ¶75-77.¹⁰

Finally, the supposed solution, a method using cheaper “lower selectivity” membranes, is not claimed in Priske-380. To the contrary, the disclosure specifically

¹⁰ The remaining “motivations” Petitioner attempts to identify fail because they are likewise too general to constitute a “design constraint or market pressure” for achieving the invention as claimed. EX2008-Geise Decl., ¶72-79. For example, a “general understanding of the trade-offs of energy costs and membrane costs,” Cor.Pet., 20-21, oversimplifies the economic considerations for a membrane gas-separation system, and more importantly would not drive a POSITA to design or arrive at the claimed invention. There are a number of operational costs (e.g., energy consumption, maintenance, labor, available space, waste) and a number of investment costs (installation, compressor, membrane, vacuum, research and development) involved. Simply knowing the cost that goes into building and operating a membrane gas-separation system and a general desire to make the system as profitable as possible is not a sufficient basis to motivate a POSITA to design a three-stage membrane gas-separation system with the specific recycle rates, membrane capacities and pressure ratios of the Challenged Claims. EX2008-Geise Decl., ¶72-79.

states that the method works with membranes that Baker characterizes as “high selectivity.”

4. Petitioner Has Not Established Why A POSITA Would Start With The Ungerank Patent

Even assuming (counterfactually) that there was a “need” for systems utilizing “lower-selectivity, lower-cost” membranes and that Comparative Example 1 discloses them, Petitioner fails to explain why a POSITA would have chosen to start with the system described in Comparative Example 1 of the Ungerank patent. The Ungerank patent teaches that the features of Comparative Example 1 are generally *undesirable* compared to other systems exemplified in Ungerank for a number of reasons. *First*, the Ungerank patent teaches that a system that requires a recycle rate this high is not economically favorable. AP1006-Ungerank patent, 11:49-52. *Second*, the Ungerank patent teaches that it is desirable—“based on requirements of various legislators”—to design a system that limits the amount of methane loss to below 0.5 percent. *Id.*, 11:62-63. Comparative Example 1, however, has a concentration of methane in the third permeate stream of 1.0 percent, indicating a greater than desirable release of methane. *Id.*, 10:57-59; *see also* AP1007-Scholz, 6. For these reasons, POSITA would not have chosen Comparative Example 1 as the starting point. EX2008-Geise Decl., ¶80-81.

The Petition and Dr. Baker identify four reasons that a POSITA would have looked to Comparative Example 1 “in the first instance.” AP1003-Baker Decl., ¶131: (1) it

employs relatively low-selectivity membranes, (2) it produces “relatively ‘Pure product streams,’” (3) it is a three-stage system with a single compressor, and (4) it provides detailed information on the gases’ compositions and flowrates, the recycle volume, the pressures, and specifies the types of membranes used. *Id.*, ¶¶131-133; EX2009-Baker Dep., 105:18-107:4. However, Dr. Baker admitted that the systems shown in Scholz Figure 7 also have all of those characteristics. EX2009-Baker Dep., 108:3-24. Petitioner has failed to point to any specific reason a POSITA would have used Comparative Example 1 as the starting point for designing a membrane gas separation system. EX2008-Geise Decl., ¶82.

Indeed, there are multiple reasons Comparative Example 1 would not have been an obvious choice to start with as compared to similar systems then available. First, the system of Comparative Example 1 is so small (bench-level scale), that even Dr. Baker conceded that it is not likely to be a commercially useful starting point. *See*, EX2009-Baker Dep., 127:4-11. Second, the membranes used in Comparative Example 1 were uncommon at the time and were not available from the major membrane suppliers. EX2009-Baker Dep., 143:6-16. In short, neither Petitioner nor Dr. Baker can point to any distinguishing features of Comparative Example 1 that would lead a POSITA to start there—and then modify Comparative Example 1 to achieve the claimed invention. EX2008-Geise Decl., ¶83. *See St. Jude Med., LLC v. Snyders Heart Valve LLC*, 977 F.3d 1232, 1243 (Fed. Cir. 2020) (affirming the “Board’s determination that St. Jude did not

adequately or persuasively establish the motivation to make the particular combination it proposed in arguing obviousness”); *see also Samsung Elecs. Co. v. Dynamics Inc.*, No. 2021-2352, 2022 WL 3041158, at *3 (Fed. Cir. Aug. 2, 2022) (no motivation to combine where the proposed combination “would not improve the functionality” of the proposed base reference).

5. A POSITA Would Not Have Been Motivated To Combine Scholz With The Ungerank Patent

Even if a POSITA would have been motivated to start with Comparative Example 1 of the Ungerank patent, a POSITA would not have been motivated to make the combination suggested by Petitioner.

First, the sole motivation that the Petitioner identifies for a POSITA to look to Scholz is that “Comparative Example 1 does not provide details on the membranes’ areas (or their ratios).” Cor.Pet., 19; *see also id.*, 23. That is wrong. Ungerank Comparative Example 1 provides specific make and model information, and states that a module was used in each of its separation stages and, therefore, that the area ratios are 1:1. Specifically, for Comparative Example 1, Ungerank states that “each stage consisted of a hollow fiber membrane module consisting of hollow polyimide fibers from UBE (NM B01 A type).” AP1006-Ungerank, 10:24-27. As Dr. Baker concedes (EX2009-Baker Dep., 78:20-79:17), modules are typically a unit containing membrane material with a fixed size. Since Comparative Example 1 describes “[e]ach stage consisted of a ...

module,” each stage in Ungerank had the same area, meaning the area ratios of all stages are 1:1. AP1006-Ungerank, 10:25. Thus, because Ungerank expressly states that the same membrane module was used in each stage, a POSITA would have known exactly what the membrane area ratios were, and would not need to turn to Scholz. EX2008-Geise Decl., ¶84-85.

Moreover, even if a POSITA would need more information than the membrane area ratios, he or she could readily determine the membrane capacity, permeance, and areas of the module used, for example by physical inspection of the UBE module and through testing the permeation of Nitrogen (grade 4.8) through the module at the standard conditions defined in Priske-'380. EX2008-Geise Decl., ¶86. Given the other information provided by Ungerank (membrane selectivity, flow rates, and pressures), a POSITA could then set up an Aspen or ChemCad model of the process and further manipulate the process. EX2008-Geise Decl., ¶87; *see also* EX2009-Baker Dep., 60:9-17. There is no record basis for Petitioner's assertion that Ungerank is silent as to membrane surface areas.

Second, as Dr. Baker testified, Comparative Example 1 is functionally complete and there was no need to improve on it.

Q. But I think what you just said is that somebody looking and reading at Ungerank Comparative Example 1 would understand that [Comparative Example 1] is an operative system that accomplishes its objective, correct?

A. That's correct.

Q. And you – they won't have seen some deficiency in that system, correct?

A. There's nothing in there that jumps out at you as a problem.

EX2009-Baker Dep., 113:21-114:8; EX2008-Geise Decl., ¶88.

Because there is no information (i.e., membrane size information) missing from Ungerank's description of the Comparative Example 1 system and no reason identified for a POSITA to be motivated to change that system, the Petition fails to show there is a reason to combine Scholz Figure 7(a) or Figure 7(b). EX2008-Geise Decl., ¶88. Petitioner's motivation to combine argument therefore fails. *See Redline Detection, LLC v. Star Envirotech, Inc.*, 811 F.3d 435, 452 (Fed. Cir. 2015) (affirming the Board's determination of non-obviousness where there was "no rational underpinning" for the proposed combination).

Rather than set out a reasoned motivation to combine theory supported by evidence, Petitioner simply takes disparate elements of the Ungerank patent and Scholz and contends that a POSITA would have been motivated to combine them based on a general "need for systems with lower-selectivity, lower cost membranes." Cor.Pet., 20. But this conclusory analysis fails to identify why a person of skill in the art *would* select these particular teachings even if they *could*. *Adidas AG v. Nike, Inc.*, 963 F.3d 1355, 1359 (Fed. Cir. 2020) ("The obviousness inquiry does not merely ask whether a skilled artisan could combine the references, but instead asks whether 'they would have been motivated

to do so.”). Petitioner’s rationale for selecting Comparative Example 1 from the Ungerank patent with Figures 7(a) or 7(b) of Scholz thus relies on impermissible hindsight. *Cheese Systems, Inc. v. Tetra Pak Cheese and Powder Systems, Inc.*, 725 F.3d 1341, 1352 (Fed. Cir. 2013) (“Obviousness ‘cannot be based on hindsight combination of components selectively culled from the prior art to fit the parameters of the patented invention.’”).

It is only through hindsight that a person of ordinary skill in the art would have been led to the specific features of the Ungerank patent’s Comparative Example 1 for which the Petitioner relies. The Ungerank patent does not state or otherwise suggest that if energy costs were low, a POSITA would turn specifically to Comparative Example 1 as opposed to, for example, one of the simpler prior art systems as disclosed in Figures 2 through 10. And more specifically, the Ungerank patent does not teach (i) that a POSITA would take a different approach to membrane gas-separation where energy costs are lower; (ii) that in those circumstances a relatively high recycle rate volume would be desirable; (iii) that a pressure quotient ratio of 0.5 to 8 would be optimal; or (iv) that a particular total capacity ratio might be optimal. EX2008-Geise Decl., ¶90.

With respect to Scholz, Petitioner has similarly provided no explanation for *why a POSITA would have selected the membrane area ratios* of Figures 7(a) and 7(b) for combination with the Ungerank Patent. Scholz uses a model (the full details of which he does not disclose) to design optimal gas membrane and separation processes under certain

design constraints. The Scholz model keeps certain assumptions fixed—for example, the underlying energy costs—and varies certain other features (for example, membrane type, membrane permeance and required recovery percentage). The output of the Scholz model includes an optimal process layout together with certain optimized process parameters—including the optimal number of stages, the surface areas of the membranes at each stage, the pressure ratios, the methane purity and recovery. EX2008-Geise Decl., ¶91.

Petitioner fails to explain why a person of ordinary skill in the art would take one parameter from this optimized design—namely the *membrane surface area*—and combine it with Comparative Example 1. The specific membrane surface area values identified in Figures 7(a) and 7(b) have no particular significance outside the context of Scholz's optimal designs for the specific parameters Scholz set for each different scenario. The Scholz model provides no teaching for what membrane surface areas to select for the feed separation and retentate separation stages in other scenarios, and, in fact, Scholz teaches that a POSITA *should not use heuristics or experience* to design multistage gas permeation processes, because doing so often results in “sub-optimal separation processes.” AP1007-Scholz, 1. EX2008-Geise Decl., ¶92.

Faced with the options presented, if anything a POSITA would have been motivated to combine Figures 5, 8(a) or 8(b) – rather than Figures 7(a) or 7(b) – with the Comparative Example 1. Those figures showed higher profits, lower costs and greater (or equal) recovery than compared to either of the process designs shown in Figure 7.

Indeed, with respect to Figure 7(a), a POSITA would have recognized that the disclosed process had unacceptable purity/recovery levels. EX2008-Geise Decl., ¶93. Further, as noted by both Scholz and the Ungerank patent, purity/recovery levels of 99.5% are required to meet certain regulatory requirements in many countries, and neither Comparative Example 1 of the Ungerank patent or Figure 7(a) of Scholz were able to achieve such a desired purity/recovery level. Thus, a person of ordinary skill in the art would not have been motivated to combine the two processes—especially since both processes were for the separation of biogas in this highly regulated field—because it would not have produced a commercially usable process. *See, e.g., Plas-Pak Indus. v. Sulzer Mixpac AG*, 600 F. App'x 755, 760 (Fed. Cir. 2015) (nonprecedential) (affirming nonobviousness determination because where IPR challenger's proposed combination would “render [prior art device] ‘inoperable for its intended purpose,’ and a person of ordinary skill would thus not have been motivated to pursue the combination) (quoting *In re Gordon*, 733 F.2d 900, 902 (Fed. Cir. 1984)).

With respect to Figure 7(b), a person of ordinary skill in the art would not have been motivated to select the process layout of Figure 7(b), because it was not an economically favorable system *under the assumptions of the Scholz model itself*:

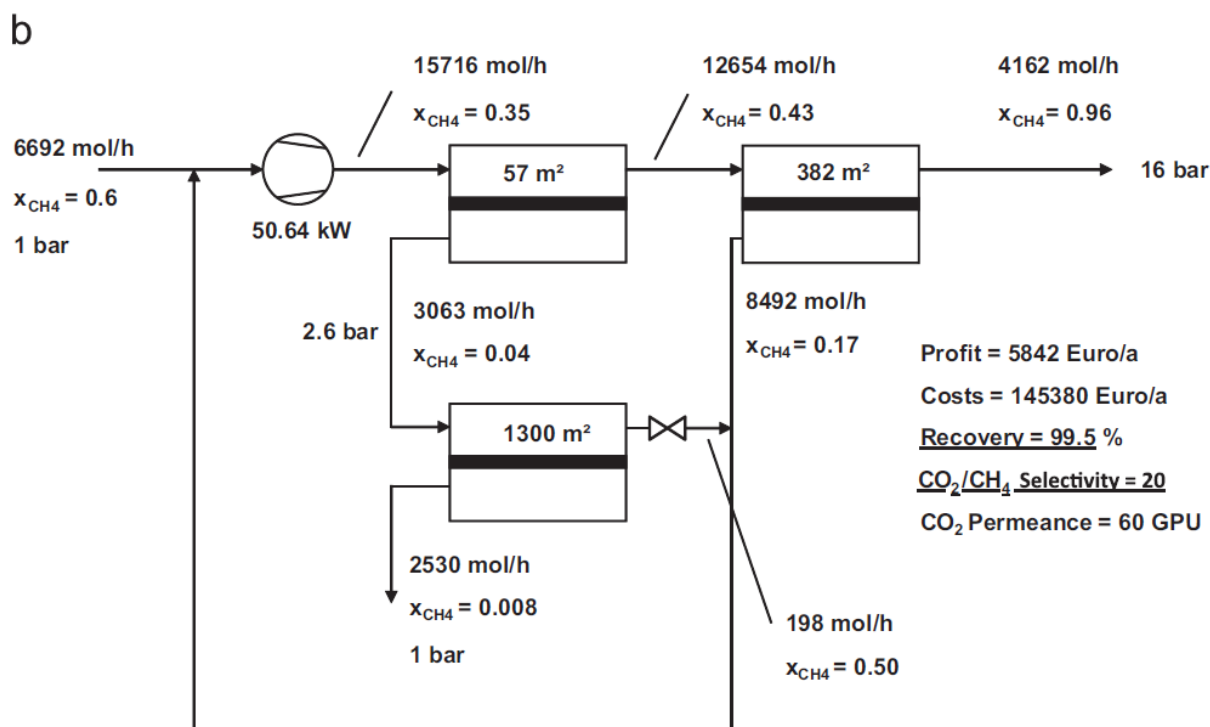


Figure 7(b) shows that under the assumptions of the Scholz model, achieving the desired purity using a membrane with a CO₂/CH₄ selectivity of 20 necessitates a process layout with significant costs and the lowest profitability of any of the examples shown in Scholz. For at least this reason, the design features of 7(b) are not desirable for combining with the Ungerank patent. EX2008-Geise Decl., ¶94.

6. Petitioner Has Not Demonstrated A Reasonable Expectation Of Success At Combining Comparative Example 1 With Scholz Figures 7(A) And 7(B)

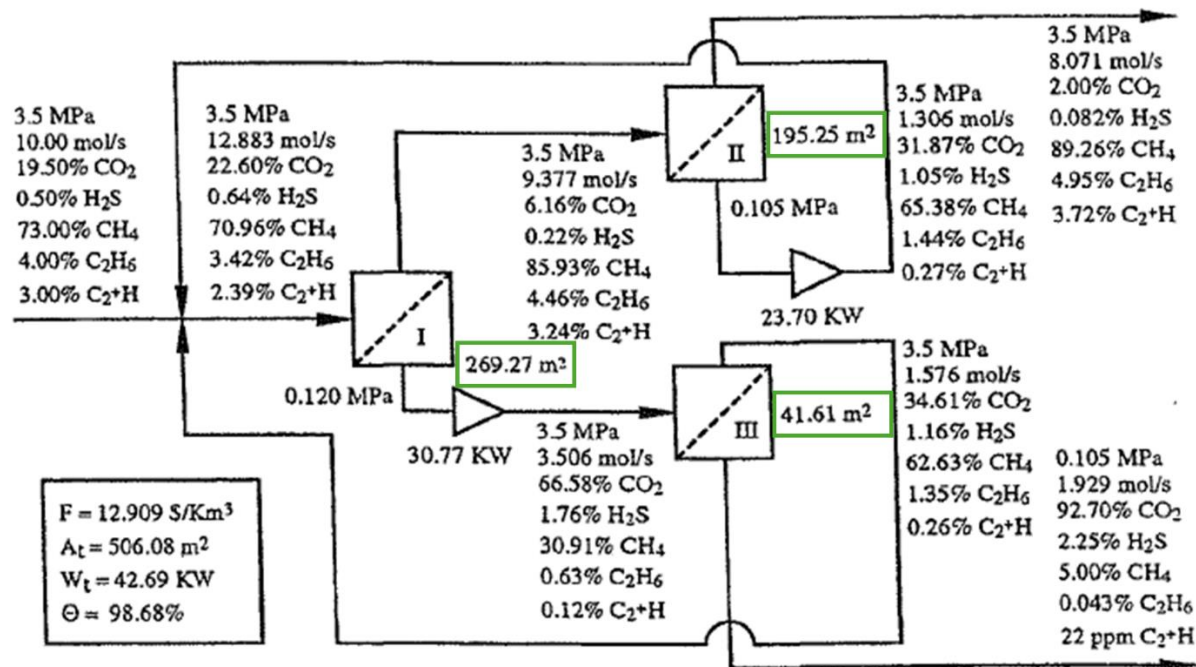
Petitioner has further failed to show that a person of skill in the art would have a reasonable expectation of success combining the disparate teachings of the Ungerank patent with those of Scholz and achieving the claimed invention. Ground I therefore fails even if the Board agrees with Petitioner (which it should not) that a POSITA would have

been motivated to combine Comparative Example 1 of the Ungerank patent and Scholz Figures 7(a) and 7(b). EX2008-Geise Decl., ¶§X.A.1.e. *See Eli Lilly & Co. v. Teva Pharms. Int'l GmbH*, 8 F.4th 1331, 1344 (Fed. Cir. 2021) (“We ... emphasize the clear distinction in our case law between a patent challenger’s burden to prove that a skilled artisan would have been motivated to combine prior art references and the additional requirement that the patent challenger also prove that the skilled artisan would have had a reasonable expectation of successfully achieving the claimed invention from the combination.”).

As an initial matter, Petitioner’s analysis of reasonable expectation of success is legally defective. The question is not whether a POSITA would have had “confidence that *a design* based on these teachings [of the Ungerank patent and Scholz] would work,” Cor.Pet. at 24, the definition applied by its expert, but rather whether a POSITA would have had a reasonable expectation of “achieving *the claimed invention* from the combination.” *See Eli Lilly*, 8 F.4th at 1344). Petitioner does not address that question. *See Cor.Pet.*, 24-25. In fact, its expert Dr. Baker did not simulate any system that would meet all the claim limitations of the challenged claims, let alone simulate and such system based on the parameters set forth in Comparative Example 1 and Figures 7(a) or 7(b), to show that it would be expected to work. EX2009-Baker Dep., 129:12-24.

Depending on the particular design constraints of a given system, there are a very large number of considerations that must be taken into account and potentially a large

number of potential solutions that could be considered. Even within the references that Dr. Baker identifies in his declaration, a large number of *potential parameter modifications* are taught that could be considered. For example, while the model in Scholz suggests that under the conditions used to generate Figures 7(a) and 7(b) a three-stage separation system where the feed stage has a smaller membrane surface area than that of the second separation stage; Qi and Henson suggests the opposite at Figure 9:



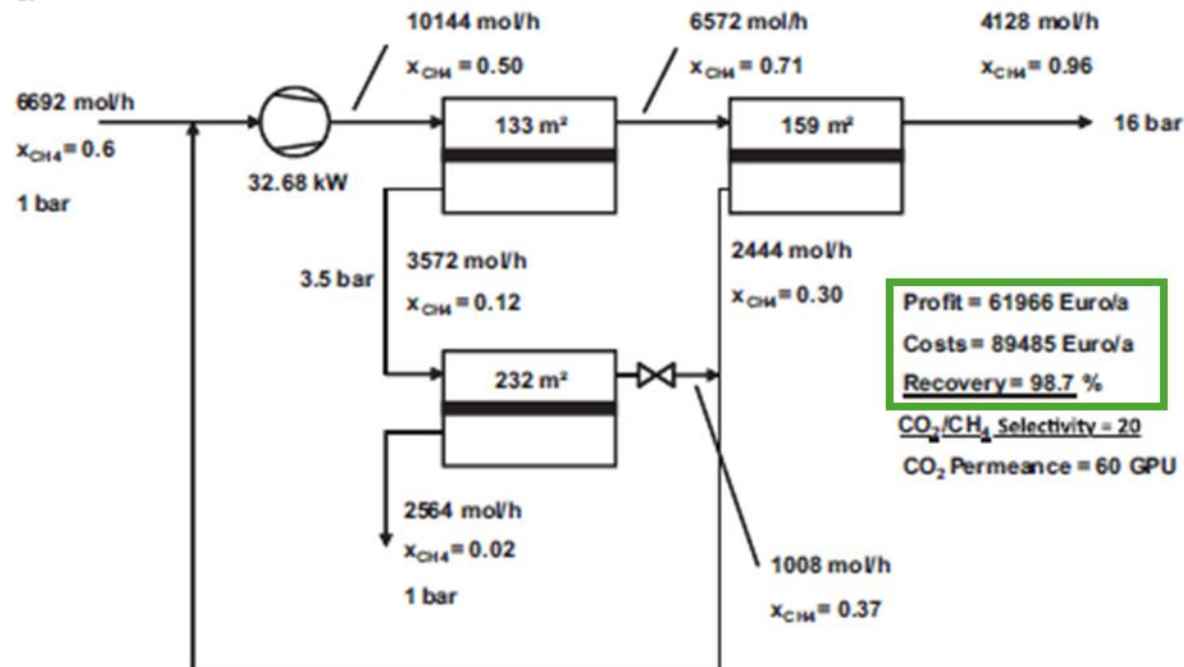
AP1009-Qi, Fig. 9.; EX2009-Baker Dep., 167:4-168:15.

Given the large number of variables that could be modified, and that the effect of each of these variables is interdependent on a number of other variables, assumptions or other design constraints—absent further guidance—a POSITA would not have had a reasonable expectation of success at selecting the surface membrane ratios taught in

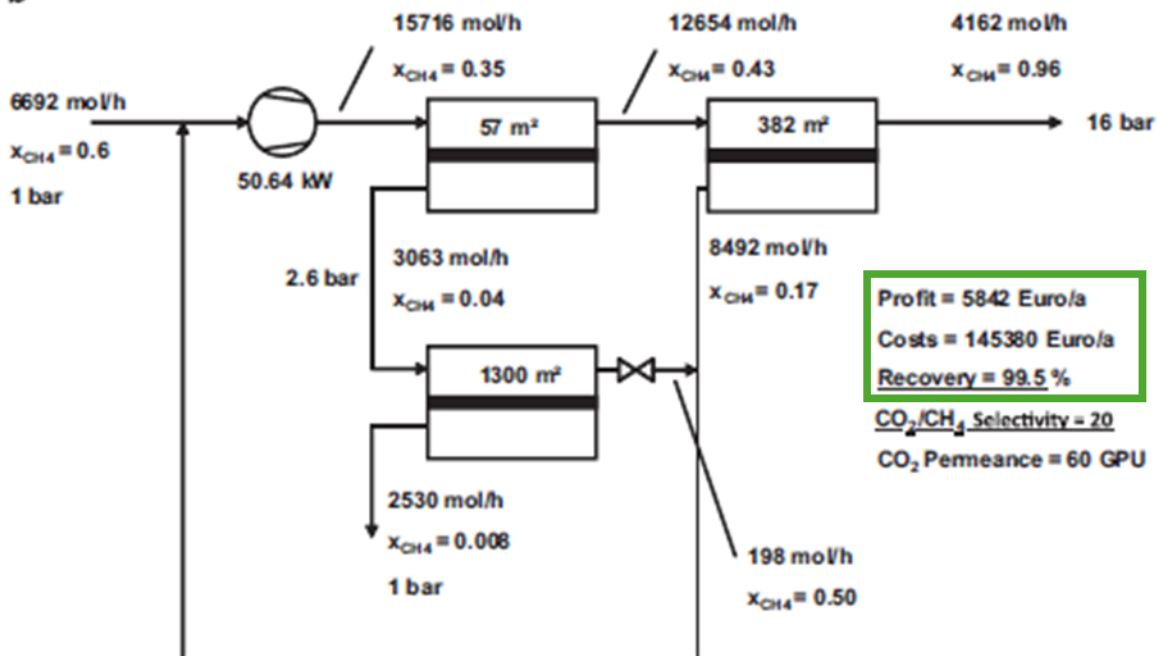
Figures 7(a) and/or 7(b) for combination with another system with a reasonable expectation of success. *See Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1365 (Fed. Cir. 2007) (quoting *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006)) (Vacating obviousness rejection in part because “to have a reasonable expectation of success, one must be motivated to do more than merely to vary all parameters or try each of numerous possible choices until one possibly arrived at a successful result.”). EX2008-Geise Decl., ¶97.

Even seemingly small design choices can have disparate effects on the overall system. This concept is exemplified by the differences between Figure 7(a) and Figure 7(b) of Scholz. For both models described in Scholz, the same membrane composition, CO₂/CH₄ selectivity, and CO₂ permeance were selected; moreover, the economic and other assumptions were kept constant as well. The only difference between the output of Figure 7(a) and Figure 7(b), was that for Figure 7(a) the recovery was found optimized at least 98.7% across a range starting at 99.5%, while the recovery for Figure 7(b) was fixed at 99.5%. This difference is seemingly small, but important because European laws require that methane recovery systems have a minimum recovery of 99.5%. What Scholz teaches is that achieving a legally permissible level of purity using a membrane with these particular characteristics comes with a very large cost in terms of profitability and costs of the overall system:

a



b



Thus, even small changes to a system requirement, like recovery in Scholz's Figure 7(a), can lead to large and unpredictable changes to the feasibility of a membrane gas-separation system. EX2008-Geise Decl., ¶98.

Further, the Scholz model includes a number of assumptions and fixed constants that are not the same as the Ungerank patent, nor reflective of real-world conditions. For example, Scholz assumes isothermal conditions across the entire membrane gas-separation system. This is rarely or never true in real life, and it is not the assumption of Comparative Example 1. As explained in Priske-'380, temperature is a variable that can affect the total capacity of each membrane—where temperature varies across the different membrane stages, total capacity *will not* correlate directly with the surface area of the membrane anymore. AP1001-Priske-'380, 3:1-3; EX2008-Geise Decl., ¶¶99-100.

Moreover, the Scholz model assumes that the system involves ideal gases—a condition rarely encountered in real-world applications—and does not account for concentration polarization or variations in selectivity, both of which are critical factors in the separation of mixed gas systems. Concentration polarization can lead to performance losses by creating gradients that reduce the driving force for separation, while changes in selectivity can significantly impact the efficiency and effectiveness of separating gases with similar properties. It would not be reasonable from the perspective of a POSITA to extract the specific surface area membrane values from *any figure generated by this model* and combine them with another system while maintaining a reasonable expectation of

success, as the model's assumptions and omissions fail to reflect the complexities of real-world gas separation processes. EX2008-Geise Decl., ¶¶101-102.

Even if a POSITA were motivated to pluck individual values from the output of Scholz, they would not have had a reasonable expectation of successfully combining those membranes or their ratios with Comparative Example 1 of the Ungerank Patent due to the differences in scale between Comparative Example 1 and Scholz (EX2009-Baker Dep., 127:4-11), the differences in the membranes, and the unrealistic assumptions included in the Scholz model. EX2009-Baker Dep., 124:12-126:8); EX2008-Geise Decl., ¶¶103-104.¹¹

Given these limitations, there was no basis for a POSITA to have a reasonable expectation of success that in combining the disparate features of Comparative Example 1 and Scholz Figures 7(a) and 7(b) the POSITA would achieve the claimed invention. *See Grunenthal GMBH v. Alkem Lab'ys Ltd.*, 919 F.3d 1333, 1344 (Fed. Cir. 2019) (Affirming obviousness determination where the prior art did “not provide any guidance as to *how* the different solvents, varying temperatures, rates of agitation, or other variables ... should be manipulated.”).

7. Petitioner Has Failed To Meet Its Burden With Respect To Dependent Claims 9, 12, And 17 For Additional Reasons

¹¹ Dr. Baker considered Figure 7B to be flawed, and stated he would have changed the interim pressure, which would have reduced the membrane area. 124:12-126:8

a) **Claim 9: “wherein the combined gas volume recycled with the second permeate stream and the third retentate stream is from 65 to 85% of the volume of the crude gas stream”**

Petitioner concedes that the claimed recycle volume range of 65 to 85% is not found in the Ungerank patent. Cor.Pet., 34-35. Instead, Petitioner relies on a single recycle volume disclosed in Comparative Example 1, 86.7%, to argue that the claimed range would have been obvious to a POSITA. *Id.* Petitioner is incorrect; “proximity alone is not enough to establish a prima facie case of obviousness.” *In re Patel*, 566 F. App’x. 1005, 1009 (Fed. Cir. 2014) (finding that a range disclosed in prior art which abutted—but did not overlap—the claimed range was insufficient to render the claimed range obvious).

Petitioner’s argument fails in the first instance because it relies upon a flawed interpretation of *Titanium Metals*. The claim in *Titanium Metals* recited a titanium alloy containing 0.3% molybdenum (“Mo”) and 0.8% nickel (“Ni”), whereas the prior art disclosed two discrete alloys of the same metals on either side of the claimed alloy, one with values slightly below the claim requirements (0.25% Mo and 0.75% Ni), the other with values slightly above the claim requirements (0.31% Mo and 0.94% Ni). Critically, Federal Circuit found that the disclosed proportions of the two prior art examples – one on each side of the claimed proportions – were “so close” to the proportions claimed that a POSITA “would have expected them *to have the same properties*,” and the patentee

“produced no evidence to rebut that” conclusion. *Titanium Metals Corp. of Am. v. Banner*, 778 F.2d 775, 783 (Fed. Cir. 1985).

Unlike in *Titanium Metals*, Comparative Example 1 of the Ungerank patent discloses only one recycle volume. Further, Petitioner has not shown that value is “so close” that a POSITA “would have expected it to have the same properties” as in *Titanium Metals*. Rather, Dr. Baker states only that such differences “do not *typically* cause *substantial* differences in performance.” AP1003-Baker Decl., ¶174. Further, Dr. Baker’s conclusory statement that a ~2% difference in recycle volume would not have a significant effect on a system’s performance is not only unsupported by any scientific literature or experimental evidence but is also incorrect. EX2008-Geise Decl., ¶106.

Next, Petitioner argues that a POSITA would have used simulation software to test a variety of ranges until it achieved a recycle volume within the claimed range. Petition at 34-35, AP1003-Baker Decl., ¶¶173-176. But Petitioner points to nothing in the prior art suggesting *why* a person of skill in the art would vary the recycle volume, let alone to arrive at a value in the claimed range. *See Chemours Co. FC, LLC v. Daikin Indus.*, 4 F.4th 1370, 1377 (Fed. Cir. 2021) (Where the prior art does not disclose an overlapping range, obviousness requires “a reason to attempt to get within the claimed range.”) (quotation omitted). In contrast to the situation in *Titanium Metals*, which simply involved varying the percentage of molybdenum and nickel in an alloy, the recycle volume of a simulated process is not a parameter that is independently varied—instead,

the designer specifies certain target outcomes (such as product purity or recovery) and the modeling system will solve for system operation variables, including recycle volume, that will achieve the target outcomes. For at least this reason, a POSITA would not—indeed, could not—model specific recycle volumes independently, as Petitioner suggests, simply to look at the impact on profitability without considering the effect of the variance on the other aspects in the system. EX2008-Geise Decl., ¶121.

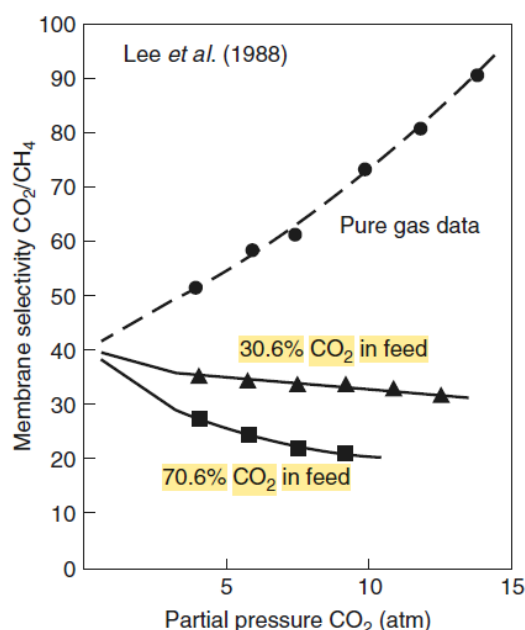
Moreover, Comparative Example 1 and the Figure 7(a) and 7(b) embodiments in Scholz are based on the results of simulation software and do not teach the claimed range of recycle volumes. The Ungerank patent teaches that recycle volumes at or below 60% are desired and has four different examples of such recycle volumes (31.2%, 35.6%, 41.7%, and 36.6%). AP1006-Ungerank patent, 11:1-14:44. The only example of Ungerank that is not below 60% is Comparative Example 1, which teaches another recycle volume outside of the claimed range at 86.7% and which Ungerank itself describes as yielding inferior results. *Id.*, 10:15-67, 11:49-52; EX2008-Geise Decl., ¶81. Scholz teaches several “optimal” results for various constraints yet still discloses recycle volumes well below and above the claimed ranges—specifically, 24%, 52%, and 135%, each in a different model. AP1007-Scholz; EX2008-Geise Decl., ¶103. These results show that simply invoking the use of simulation software would not lead a POSITA to the range of claim 9—just as the cited references did not arrive at the claimed range either. EX2008-Geise Decl., ¶103. As a result, Petitioner’s argument that claim 9 is obvious must fail.

Finally, Petitioner's argument fails because Ground I is not based on Comparative Example 1 alone, but rather on a system that incorporates the separation membranes taught in Figure 7 of Scholz instead of the membranes used in Ungerank Comparative Example 1. Such a system would **not** have the same recycle rate as the system taught in Comparative Example 1. Petitioner has not provided any evidence that the recycle rate in this hypothetical system would be anywhere close to the claimed range. *See* EX2009-Baker Dep., 129:12-24; EX2008-Geise Decl., ¶106.

b) Claim 12: “wherein the gas separation membranes in the feed stream separation stage have a pure gas selectivity for CO₂/CH₄ of from 20 to 100”

Claim 12 of Priske-'380 requires that “the gas separation membranes in the feed stream separation stage have a pure gas selectivity for CO₂/CH₄ of from 20 to 100.” Petitioner contends that the Ungerank patent's disclosure of a mixed-gas selectivity of 20 in Comparative Example 1 would translate to a pure gas selectivity that is “not more than 500% higher”—i.e., no more than 100. Cor.Pet., 36. This position is unsupported for two reasons. First, Comparative Example 1 uses polyimide membranes, whereas the data Petitioner relies on to demonstrate a relationship between mixed-gas selectivity and pure gas selectivity pertains to cellulose acetate membranes. *See* AP1006-Ungerank, 10:66-67; AP1013-Baker Textbook, 345, Figure 8.8; EX2008-Geise Decl., ¶108. Petitioner does not state that relationship would be the same for different materials, let alone offer any evidence or reasoning. Second, even if the data Petitioner cites related to polyimide rather

than cellulose acetate, that data is insufficiently detailed to demonstrate what the pure gas selectivity would be for a mixed-gas selectivity of 20 and a feed stream including 61.2% CO₂, as in Ungerank's Comparative Example 1. See AP1006-Ungerank, 10:15-67; AP1013-Baker Textbook, 345, Figure 8.8; EX2008-Geise Decl., ¶109. The graph Petitioner relies on, reproduced below, does not include data pertaining to a 61.2% CO₂ feed stream.



AP1013-Baker Textbook, Fig. 8.8. Accordingly, Petitioner's cited evidence does not indicate what the pure gas selectivity would be for a mixed-gas selectivity of 20, or whether the pure gas selectivity would be less than (or equal to) 100 as claim 12 requires. EX2008-Geise Decl., ¶¶109-110.

- c) **Claim 17: “wherein the compressor is a multistage compressor and the second permeate stream, the third**

**retentate stream, or both are introduced into the
compressor between two compression stages”**

Petitioner’s argument that Comparative Example 1 teaches claim 17 fails because Comparative Example 1 fails to teach or suggest a “multistage compressor” where the “second permeate stream, third retentate stream, or both are introduced into the compressor between the two compression stages.” As Dr. Baker conceded, Comparative Example 1 “is [a] very small” system. He further testified that “multistage compressor[s]” are for use with a “big system[s]” not small ones like that of Comparative Example 1. EX2009-Baker Dep., 117:22-120:14. Dr. Baker’s testimony is in direct contradiction with Petitioner’s argument that a POSITA would implement Comparative Example 1 using a multistage compressor. Cor.Pet., 40; EX2008-Geise Decl., ¶¶111-112. For these reasons, Petitioner’s arguments fail.

**B. Ground II: Claims 1-13, 16-17, 21 And 23 Would Not Have Been
Obvious Over Scholz**

As the Board suggested in the Decision on Institution, 27, Ground II is even more flawed than Ground I. *Id.*, 27. In addition to the flawed analysis for limitation 1.f.ii, which is neither taught nor suggested in Scholz, Ground II relies on a purely hindsight-driven and legally flawed analysis for limitation 1.f.i and fails additionally for that reason.

**1. Petitioner Has Not Demonstrated That Scholz Renders
Limitation 1.F.I Obvious**

For limitation 1.f.i, Petitioner concedes that Scholz fails to teach a recycle volume percentage that falls within the claimed range of limitation 1.f.i (60-100%). Cor.Pet., 47

(arguing only that Scholz's disclosure would have rendered this limitation obvious). None of Petitioner's obviousness arguments for this limitation has merit.

Petitioner first incorrectly argues that the two disclosed recycle volumes of Figures 7(a) and 7(b) (51% and 135%, respectively) create a "range" encompassing the claimed range, which renders the claimed range *prima facie* obvious under *Titanium Metals*. Cor.Pet., 48. But the two disparate values reported in Figures 7(a) and 7(b) – neither one of which is close to the claimed range – for two separate models based on distinct assumptions, do not create a "range"—and neither *Titanium Metals*, nor *In re Patel*, nor *Bos. Sci. Scimed, Inc.* (Cor.Pet., 48) suggest that they do.

As explained in above, the Court in *Titanium Metals* found that a value of ".25% Mo and 0.75% Ni" and a value of "0.31% Mo and 0.94% Ni" in the prior art sufficiently close to the claimed alloy containing 0.3% Mo and 0.8% Ni. But in *Titanium Metals* the Court concluded that the prior art alloys had "proportions [that] are so close that prima facie one skilled in the art would have expected them to have the same properties." *Titanium Metals*, 783. Unlike in *Titanium Metals* where the differences constituted fractions of a percentage point difference between the claim and the prior art—here the percentages are an order of magnitude larger. Moreover, Petitioner has provided no evidence to suggest the recycle volumes disclosed by Scholz were "so close that a [POSITA] would have expected them to have the same properties." *Id.*

In fact, Scholz itself demonstrates the opposite. There are enormous differences between Figures 7(a) and 7(b) in terms of profits, costs, and optimal process conditions, illustrating the difference in properties between a recycle rate of 51% and 135% are significant. AP1003-Baker Decl., ¶206; *see also* EX2008-Geise Decl., ¶¶116-117. Petitioner's attempt to analogize the facts to *Titanium Metals* fails.

Second, citing Dr. Baker's opinions at paragraphs 205-210 (pages 73-76), Petitioner argues that a POSITA "would have had other reasons to vary the recycle percentages to achieve a recycle percentage within the claimed range." Cor.Pet., 48-49. In this regard, it points to Ungerank's 86.7% recycle rate and that the mathematical average of 51 and 135 is 91. *Id.*, 49. It also asserts that in some applications a permeate stream could be less pure, and that if a recycle percentage was lowered in Figure 7(b) it would lead "towards" the claimed range. *Id.*, 49-50.

But when examined on this portion of his declaration, Dr. Baker acknowledged that his opinion was a hindsight-driven analysis and that he lacked any data to support it. Specifically, Dr. Baker acknowledged that his opinion was solely that a POSITA *could* design a system with a recycle percentage between 60 and 100, if asked, **not** that a POSITA *would* design such a system.

Q. If we focus on your declaration at page 73 . . . to 76, in those paragraphs, you don't identify any specific motivation for a person of skill in the art to design a system that achieves a recycle rate of 60 percent or something

between 60 and 100 percent as opposed to, for example, 59 percent or 101 percent, correct?

A. Yes.

Q. And the person who's testing the system would, for example, also be testing, in your opinion, a recycle percentage of, for example, 115 percent, correct?

A. 135, yeah. I meant we're into the claims, which is sort of a legal thing. I mean, I'm – so in the claims, I – if I – I can – if the POSITA is – is told, can you make a system that's between 80 [sic] and 100 percent given this information, he can do it. If somebody tells him, I need it – it has to be, for whatever reason, I need 60 to 100, he can do it. He's got all the info he needs.

EX2009-Baker Dep., 133:4-134:21. Such testimony cannot establish obviousness. *See InTouch Techs., Inc. v. VGO Commc'ns, Inc.*, 751 F.3d 1327, 1352 (Fed. Cir. 2014) (rejecting expert testimony regarding obviousness which “primarily consisted of conclusory references to her belief that one of ordinary skill in the art *could* combine these references, not that they *would* have been motivated to do so”)(emphasis in original).

Additionally, Dr. Baker admitted that he did not perform any ChemCad or other type of simulation¹² to show the ramifications of seeking a different recycle percentage, EX2009-Baker Dep., 129:12-17, and that he did not “offer any opinions as to what the specific membrane area sizes would be for a system that would achieve any different recycle percentages” using the system depicted in either Scholz Figure 7(a) or 7(b). *Id.*, 129:18-24. Thus, Petitioner has presented the Board with no evidence that even if a POSITA did elect to modify Scholz Figure 7(a) or Figure 7(b) to achieve a recycle percentage of 86.7% or 91%, either the membrane capacity or the pressure ratio quotient limitations of claim 1 would still be met. Much less has Petitioner provided any reason that a POSITA would be inclined to test those percentages, where doing so would (1) result in a system that was not ecologically sound because it would have a methane recovery percentage lower than 99.5% and (2) result in a system that was not economically optimal for such an ecologically unfriendly design. EX2008-Geise Decl., ¶¶118-119.

In short, Petitioner and Dr. Baker have provided no evidence of (a) a motivation to design a system with a specific recycle percentage between 60 and 100; or (b) what such a system would look like. Petitioner has thus failed to meet its burden to show a

¹² Although Petitioner and Dr. Baker repeatedly point to “Aspen” simulation software throughout the petition, Dr. Baker has never used Aspen and would need someone to sit down with him to show him how it works if he ever needed to use it. EX2009-Baker Dep., 48:5-11, 61:17-25.

motivation to modify the Scholz Figure 7(a) or Sholtz Figure 7(b) system to meet limitation 1.f.i.

Indeed, there are reasons that a POSITA would specifically have been disinclined to make such a modification. For example, the Scholz model arrived at a CO₂ purity level that was above the model's requirement, meaning any deviation would result in lower profits. EX20XX, Geise Decl., ¶119. Further, altering the CO₂ purity in the third permeate stream as Petitioner suggests could mean lowering the system's CH₄ recovery. EX20XX, Geise Decl., ¶119. The sale of CH₄ is the only source of revenue in the Scholz model and the amount of CH₄ available for sale is a direct result of CH₄ recovery. AP1007-Scholz, Table 3; EX2008-Geise Decl., ¶118. As Dr. Baker acknowledged, Scholz assumes that a higher CH₄ recovery percentage equals greater revenues from the sale of the methane. Baker Dep., 102:7-14. This means that lowering the recycle volume would simultaneously lower the process revenue—something a POSITA would not be motivated to do. EX2008-Geise Decl., ¶118.

2. Petitioner Has Not Demonstrated That Scholz Teaches Limitation 1.F.Ii

For the same reasons discussed with respect to Ground I, Petitioner has failed to demonstrate that Scholz teaches limitation 1.f.ii of Priske-'380.

3. Petitioner Has Failed To Meet Its Burden With Respect To Dependent Claims 8, 9, 10, 12, And 17 For Additional Reasons

a) Claim 8: “wherein the ratio of the total capacity of the gas separation membranes in the permeate separation stage to the total capacity of the gas separation membranes in the feed stream separation stage is in a range of from 0.8 to 1”

Petitioner acknowledges that Scholz does not disclose capacity ratios that overlap with the claimed range. Cor.Pet., 56. In fact, Petitioner acknowledges there is no disclosure of a capacity ratio, *per se*, in Scholz at all. Cor.Pet., 18-19, 29. However, Petitioner asserts that the capacity ratios of 1.7 and 22.8 are sufficiently “near the high-end of the claimed range” such that the claimed range is obvious in view of Scholz. Cor.Pet., 19. Petitioner is incorrect at least because it misinterprets the values in Scholz and because its rationale for the necessary modification of Scholz is flawed.

First, Petitioner incorrectly argues that Scholz’s disclosure of membrane surface areas is the same as disclosing capacity ratios. This is incorrect at least for the reasons discussed above.

Second, Scholz’s disclosure of two discrete membrane surface area values does not constitute a “range” (whether or not they equate to capacity values). The two values disclosed for the ratio of the membrane surface area of the permeate stage to that of the feed stage in Figure 7, 1.7 and 22.8, are two discrete values that Scholz describes as corresponding to “optimal” processes. See AP1007 Scholz, Figure 7. Scholz provides no support for the proposition that the values of 1.7 to 22.8 necessarily implies that all values between them would also yield optimal results, and no reason to infer either that 1.7

constitutes the low end of an optimal range or that 22.8 constitutes the high end. *See Colas Sols., Inc. v. Blacklidge Emulsions, Inc.*, 759 F. App'x 986, 990 (Fed. Cir. 2019) (“the fact that some or most potential values may occur in a range does not confirm the actual softening point value for the specimen occurs within the range”).

Third, Petitioner's argument that a POSITA would arrive at the claimed range through mere experimentation is flawed. Arriving at the upper bound of the claimed range, 1, from the closest capacity ratio in Scholz Figure 7, 1.7, would constitute a 41% decrease in the capacity ratio ($(1.7-1)/1.7$). EX2008, Geise Decl., ¶125. Such a decrease in capacity ratio would significantly alter the process of Scholz 7(a), a process already shown as “optimal” for the specific assumptions applied. *Id.* Further, Petitioner does not address the impact that this change in capacity ratio would have on other process parameters, including the recycle volume and pressure quotient ratios. Finally, Petitioner provides no rationale for why a POSITA would consider altering the capacity ratio of permeate stage to feed stage among the many other ratios in the process, let alone the dozens of other process variables aside from capacity ratio. EX2008, Geise Decl., ¶125-127.

Thus, Petitioner's flawed and conclusory argument that claim 8 is obvious in light of Scholz must fail.

b) Claim 9: “wherein the combined gas volume recycled with the second permeate stream and the third retentate stream is from 65 to 85% of the volume of the crude gas stream”

Petitioner asserts that Figure 7 of Scholz disclose a “range” of recycle volumes from 51-135%, and thus Scholz renders the claimed range of 65-85% obvious. For the same reasons explained in Section VII.B.1, a POSITA would not have found that the recycle percentage range in Scholz’s Figure 7 renders the 65-85% range of claim 9 obvious. *See supra*; EX2008-Geise Decl., ¶¶129-131.

c) Claim 10: “wherein the quotient of the pressure ratio over the permeate separation stage to the pressure ratio over the feed stream separation stage is in a range of from 1 to 3”

Petitioner acknowledges that the pressure ratio quotients in Scholz Figure 7, 0.42 and 0.77, are outside of the claimed range of Claim 10. Cor.Pet., 57; AP1003-Baker Decl., ¶236. However, Petitioner asserts that “the high-end of the Scholz range¹³ is close to the low-end of the claimed range” which would have motivated a POSITA to test ranges that are in the claimed range, thus rendering the claimed range obvious. Cor.Pet., 57-58. This argument fails.

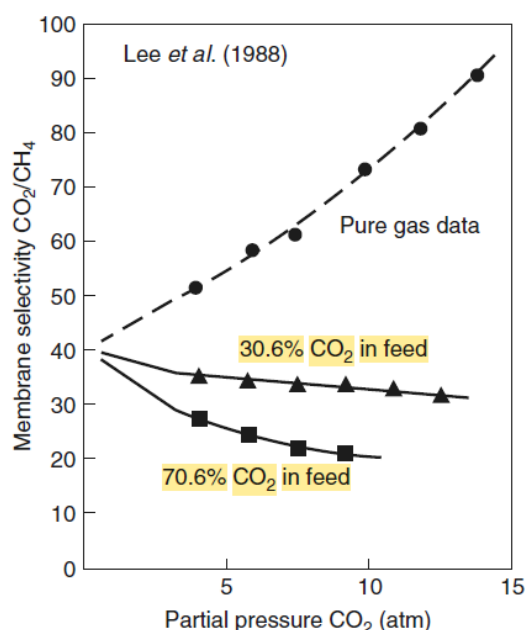
¹³ As discussed above, Scholz’s disclosure of two discrete values does not constitute a “range.” The values disclosed for pressure ratio quotient in Figure 7, 0.77 and 0.42 in (a) and (b) respectively, are two discrete values that correspond to processes Scholz describes as “optimal,” not a “range” of possible values.

Petitioner's argument is conclusory and simply assumes that a POSITA would modify the pressure ratios in the permeate stage and the feed stage, providing no rationale why a POSITA would not modify the pressure ratio quotients of other stages, let alone the dozens of other process variables a POSITA could select from. Further, the bottom of the claimed range (1), represents a 130% increase from the highest value that Scholz discloses (0.77), meaning the claimed range is not "near" to the Scholz values. EX2008-Geise Decl., ¶¶133-135.

Thus, claim 10 would not have been obvious to a POSITA based on Scholz.

d) Claim 12: "wherein the gas separation membranes in the feed stream separation stage have a pure gas selectivity for CO₂/CH₄ of from 20 to 100"

As Petitioner acknowledges, Scholz does not specify whether its disclosure of a selectivity of 20 refers to mixed-gas or pure gas, and Petitioner identifies no reason a POSITA would interpret Scholz to refer to the latter. Further, if the selectivity value of 20 disclosed in Scholz refers to mixed-gas selectivity, Petitioner's cited graph does not include data pertaining to either a 50% CO₂ feed stream such as that of Scholz's 7(a) or a 65% CO₂ feed stream such as that of Scholz's 7(b). EX2008-Geise Decl., ¶136.



AP1013-Baker Textbook, Figure 8.8. Accordingly, Petitioner's cited evidence does not indicate what the pure gas selectivity would be for a mixed-gas selectivity of 20, or whether the pure gas selectivity would be less than (or equal to) 100 as claim 12 requires. Cor.Pet., 58. EX2008-Geise Decl., ¶137. See *OSI Pharms., LLC v. Apotex Inc.*, 939 F.3d 1375, 1382, 1385 (Fed. Cir. 2019) (reversing Board's determination of obviousness where references lacked "any data or other information" regarding the proposed combination because "[m]ere speculation" is not substantial evidence") (quoting *Intellectual Ventures I LLC v. Motorola Mobility LLC*, 870 F.3d 1320, 1331 (Fed. Cir. 2017)).

Thus, claim 12 would not have been obvious to a POSITA based on Scholz.

e) Claim 17: “wherein the compressor is a multistage compressor and the second permeate stream, the third retentate stream, or both are introduced into the compressor between two compression stages”

Claim 17 requires use of a multistage compressor. A multi-stage compressor is more expensive than a single-stage compressor. EX2009-Baker Dep., 109:14-22. The Petition provides no articulation of why a multistage compressor would be used in connection with either the Figure 7(a) or Figure 7(b) embodiment as contemplated by Ground II, beyond stating that doing so would “reduce energy demand.” Cor.Pet., 60. The Petition provides no explanation – much less any calculations showing – why a POSITA would have believed that any offset in energy demand would justify the use of a more expensive compressor for a system with a recycle rate in the claimed range or with membranes with the required relative capacities in Figures 7(a) or 7(b); in fact, there would be no reason for a multistage compressor in Scholz because the crude and recycle stream are at the same pressure. EX2008-Geise Decl., ¶¶138-139. *See Redline Detection, LLC v. Star Envirotech, Inc.*, 811 F.3d 435, 452 (Fed. Cir. 2015) (affirming the Board’s determination of non-obviousness where there was “no rational underpinning” for the proposed combination).

VIII. Conclusion

The Board should find that Petitioner has failed to prove by a preponderance of the evidence that any challenged claim is invalid for obviousness.

Respectfully submitted,

Date: December 12, 2024

By: /Philip Y. Braginsky/

Philip Y. Braginsky

PATENT OWNER'S UPDATED TABLE OF EXHIBITS

Exhibit No.	Description
2001	Expert Declaration of Dr. Markus Ungerank
2002	Curriculum Vitae of Dr. Markus Ungerank
2003	Linde Engineering – Membrane Plants
2004	Anderson, Case Study – Membrane CO2 Removal From Natural Gas
2005	Expunged
2006	Declaration of Janet Linn
2007	Declaration of Gregory H. Lantier
2008	Geise Declaration
2009	Baker Deposition Transcript
2010	White, L. S. <i>Evolution of Natural Gas Treatment with Membrane Systems</i> , Membrane Gas Separation, Freeman, B., Yampolskii, Y. Eds.; John Wiley & Sons, Ltd, 2010.
2011	Matteucci et al., <i>Transport of Gases and Vapors in Glassy and Rubbery Polymers</i> , Materials Science of Membranes for Gas and Vapor Separation, 2006; pp 1-47.
2012	Robeson, L. M., <i>The upper bound revisited</i> , Journal of Membrane Science (2008) 320, 390-400.
2013	Freeman, B. D., <i>Basis of permeability/selectivity tradeoff relations in polymeric gas separation membranes</i> , Macromolecules 1999, 32 (2), 375-380.
2014	Puleo et al., <i>The effect of degree of acetylation on gas sorption and transport behavior in cellulose acetate</i> , Journal of Membrane Science, 47, 301-332, 1989.
2015	He et al., <i>Theoretical study on concentration polarization in gas separation membrane processes</i> , Journal of Membrane Science, 153, 243-258, 1999.

CERTIFICATE OF WORD COUNT UNDER 37 C.F.R. § 42.24(d)

I hereby certify that the foregoing Patent Owner's Response contains 13997 words as measured by the word processing software used to prepare the document, in compliance with 37 C.F.R. § 42.24(d), excluding the parts exempted from the word count by 37 C.F.R. § 42.24(a)(1).

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CERTIFICATE OF SERVICE

I hereby certify that on December 12, 2024, I caused a true and correct copy of the following documents:

- Patent Owner's Response
- Certificate of Word Count Under 37 C.F.R. § 42.24(d)
- Patent Owner's Updated Exhibit List
- Exhibits EX2008-EX2015

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IPR55766-0003IP1@fr.com

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