United States District Court,
D. Delaware.

KX INDUSTRIES, L.P. and Koslow Technologies Corporation,
Plaintiffs.
v.
CULLIGAN WATER TECHNOLOGIES, INC., and Plymouth Products, Inc,
Defendants.

No. Civ.A. 98-88-RRM

March 3, 1999.

Owner of patents for extruding carbon blocks used in water filters sued competitor for infringement. Construing disputed claim language, the District Court, McKelvie, J., held that: (1) "Substantially uniform mixture" of particles referred largely, but not wholly, to distribution of particles; (2) "means for heating" particles, referred to heating elements described in specification; (3) "whereby" clause added limitation to claim; and (4) heating of particle mixture "substantially above the softening temperature" required heating of mixture sufficiently above softening temperature of binder particles to allow conversion of binder to continuous web matrix or forced point-bonds.

Claims construed.

Requirement that binder particles be "substantially incapable of fibrillation under normal conditions," called for in patent claim for extruding carbon blocks used in water filters, meant that binder particles had to be substantially incapable of forming fibers of less than 10 micrometers diameter by shear and pulling alone without heating or substantial compression.

Steven J. Balick, and Steven T. Margolin, Ashby & Geddes, Wilmington, Delaware; Gregory L. Diskant, Jeffrey I.D. Lewis, Scott B. Howard, and Benjamin Levi, Patterson, Belknap, Webb & Tyler LLP, New York City, for plaintiffs.

Karen Valihura, Skadden, Arps, Slate, Meagher & Flom LLP, Wilmington, Delaware; Constance S. Huttner, and Paolo A. Ramundo, Skadden, Arps, Slate, Meagher & Flom LLP, New York City, and Thomas G. Rohback, LeBouf, Lamb, Greene & MacRae LLP, Hartford, Connecticut; for defendants.

OPINION

McKELVIE**, District Judge.**

This is a patent case. Plaintiff KX Industries, L.P. is a limited partnership organized under the laws of Delaware with its principal place of business in Orange, Connecticut. Plaintiff Koslow

TechnologiesCorporation is a Connecticut corporation with its principal place of business in Orange, Connecticut. Koslow Technologies is the owner of U.S.Patents Nos. 5,249,948 ("the "8 patent"), 5,189,092 ("the '092 patent"), 5,147,722 ("the '722 patent") and 5,019,311 ("the '311 patent"), all pertaining to extruded carbon blocks used in water filters. KX Industries is the exclusive licensee of the "8, '092, '722, and '311 patents. Defendant Culligan Water Technologies, Inc. is a Delaware corporation with its principal place of business in Northbrook, Illinois. Defendant Plymouth Products, Inc. is a Delaware corporation with its principal place of business in Sheboygan, Wisconsin.

Plaintiffs filed a complaint on February 24, 1998, alleging defendants have willfully infringed and continue to willfully infringe the "8 patent, that defendants have engaged in false advertising, and that defendants misappropriated KX Industries' trade secrets. On May 12, 1998, plaintiffs filed an amended complaint alleging, in addition, defendants have willfully infringed and continue to willfully infringe the '092, '311, and '722 patents.

On May 19, 1998, defendants filed an answer denying plaintiffs' claims and asserting counterclaims, including non-infringement and invalidity of the '092, "8, '311, and '722 patents. On October 28, 1998, defendants filed an amended answer asserting various defenses, including the affirmative defense of unenforceability of the "8, '311, and '722 patents. On November 24, 1998, this court dismissed with prejudice claims including plaintiffs' false advertising claim and defendants' counterclaim and affirmative defense of unenforceability of the "8 patent pursuant to the parties' stipulation.

On February 11, 1999, the court held a hearing in accordance with Markman v. Westview Instruments, Inc., 517 U.S. 370, 116 S.Ct. 1384, 134 L.Ed.2d 577 (1996) to construe disputed claims of the '092, "8, '311, and '722 patents. This is the court's construction of those disputed claims.

I. *FACTUAL BACKGROUND*

The court draws the following facts from the parties' evidentiary submissions, and the testimony and evidence presented during the claim construction hearing.

A. *The Parties*

Koslow Technologies is the owner of the '092, "8, '311 and '722 patents. KX Industries is the exclusive licensee of these patents. KX Industries develops, manufactures and sells carbon blocks used in residential and commercial water filters. The court shall refer to the two plaintiffs collectively as "KXI." Dr. Evan E. Koslow is the inventor of the '722, '092, and '311 patents, and the joint inventor of the "8 patent. He is KX Industries' founder and CEO, and Koslow Technologies' founder and president.

Culligan Water Technologies manufactures and sells water filtration systems and related products, including carbon block filters. Culligan makes some of its carbon block filters by an extrusion process using carbon and a binder. Since this action commenced, Culligan Water Technologies has been acquired by United States Filter Corporation. Plymouth has been a wholly-owned subsidiary of Culligan Water Technologies since August 1997. Plymouth manufactures and sells a variety of water filtration products, including the extruded carbon blocks which are the subject of the patent infringement claims. The court shall refer to the two defendants collectively as "Culligan."

B. *The Technology*

Carbon block filters are solid filters that use carbon to remove particulate and chemical impurities and offensive odors from water. They are made of granular activated carbon and a plastic binder material that has a lower softening temperature than carbon. Carbon block can be made through extrusion or molding processes. In both processes, the carbon and binder are mixed together and then heated to a temperature above the softening or melting point of the binder, but below that of the carbon. As a result, the binder softens and surrounds the carbon particles, while still leaving voids and pores that expose carbon particles and allow water to pass through the block.

Extrusion is the process of forcing a material through a die. A well-known example of an extruder is a pasta maker, in which dough is mixed and then forced down a tube until it passes through a die that shapes it into a form. Making extruded carbon block involves feeding a powdered mixture of granular activated carbon and a binder into an extruder, heating the mixture to a temperature above the softening temperature of the binder but below that of the carbon, pushing the mixture through a die which shapes the block, then applying pressure and cooling the block so it forms a solid material.

C. *The Patents*

1. *The* '311 Patent

The '311 patent is entitled "Process for the Production of Material Characterized by a Continuous Web Matrix or Force Point Bonding." It discloses a method for forming a composite material from primary particles and binder particles which have a lower softening temperature than primary particles. The particles are mixed together to create a "substantially uniform mixture" and then are heated to a temperature above the softening point of the binder particles, but below that of the primary particles. The softened binder particles partially fill the spaces between the primary particles. The patent's specification and claims disclose applying pressure and shear to the mixture to create bonds between the primary particles and the binder particles. The patent's specification describes the resulting bonds as a "substantially continuous webbing structure" or as "forced point-bonds." The patent's specification and claims disclose "rapidly" cooling the mixture to stabilize the composite material. The resulting product is a porous solid in which the binder forms a structure supporting the primary particles.

Claims 1 and 94 of the '311 patent teach the process for forming the composite material. The claims disclose the application of pressure and shear "to convert at least a portion of the binder material particles into a substantially continuous webbing structure through the composite material." "Continuous webbing matrix" is defined in the '311 patent specification as "a thin, substantially continuous film or 'web'." U.S.Patent 5,019,311, col. 4, lines 42-45. The specification further describes the matrix as a "continuous phase" but with voids present, resulting in a permeable structure with a "large volume of pores filled with air or other atmospheric gas." Id. at col. 5, lines 27-34.

Claim 94 of the '311 patent discloses the application of pressure and shear to "cause forced point-bonding of the particles of the primary material by the binder material." "Forced point-bonds" are described in the '311 patent's specification as having "adhesive-like bonds between the particles caused by the melting of the binder resin and squeezing this material to a point insufficient to consolidate into a continuous web." Id. at col. 15, lines 21-25.

a. *Prosecution History*

The predecessor application to the application which led to the '311 patent is Application Serial No.

07/314,615. It is entitled "Process for the Production of Materials by In-Situ Fiberizing and Force Point Bonding and Materials Produced by the Process." Koslow originally filed the predecessor application with the Patent and Trademark Office ("PTO") on February 23, 1989. On November 20, 1989, the PTO issued an office action finding the invention in claims 1-86 and 166-182 ("group I claims") distinct from the invention in claims 87-165 and 183-191 ("group II claims"). According to the PTO, the group I claims were "drawn to a method of forminga composite material by either force point bonding or in-situ fiberizing techniques," and the group II claims were "drawn to a composite material[.]" The PTO restricted the applicant to one of the inventions, pursuant to 35 U.S.C. s. 121. On December 19, 1989, Koslow elected to continue to prosecute the group I claims in this application.

On December 22, 1989, Koslow filed the application which led to the '311 patent, known as Application Serial No. 07/455,997. This was filed as a continuation-in-part of the co-pending 07/314,651 application. The application is entitled "Process for the Production of Materials and Materials Produced by the Process."

On February 5, 1990, the PTO issued a notice of allowability, allowing claims 1-86 and 166-182 of the 07/314,651 application. On July 23, 1990, the applicant expressly abandoned the 07/314,651 application pursuant to 37 CFR 1.138, in favor of the application which led to the '311 patent.

On July 25, 1990, the PTO issued a notice of allowability, allowing claims 1-86, 166-182, 192-205, and 207 of the application. The '311 patent issued on May 28, 1991 under the title "Process for the Production of Materials Characterized by a Continuous Web Matrix or Forced Point-Bonding." Koslow assigned the '311 patent to Koslow Technologies Corporation.

b. *Disputed Terms*

KXI claims Culligan has infringed claims 87 and 94 of the '311 patent. Claim 87 is dependent upon claim 1 of the '311 patent. These claims read as follows, with disputed terms and phrases in italics:

1. A method of forming a composite material which comprises:

providing a quantity of first particles of a binder material, said first particles having diameters between about 0.1 and about 150 micrometers;

providing a quantity of second particles of a primary material having a softening temperature substantially greater than the softening temperature of said binder material, said second particles having diameters between about 0.1 and about 3,000 micrometers;

combining the first and second quantities of particles in a substantially uniform mixture wherein said binder material is present in an amount of at least about 3% by weight of the mixture;

heating said substantially uniform mixture, *in the absence of pressure or shear sufficient to convert the binder particles into a continuous phase through the composite material,* to a temperature *substantially above* the softening temperature of said binder material but to a temperature less than the softening temperature of said primary material;

thereafter applying *pressure and shear to the heated mixture sufficient substantially immediately to convert at least a portion of the binder material particles into a substantially continuous webbing structure through*

the composite material; and

substantially immediately after formation of said continuous binder structure, rapidly cooling said mixture to below the softening point of the binder material to retain said converted binder material in its continuous webbing structure condition to produce the composite material.

87. The method of claims 1, 3, 5, 7, 9, or 15 wherein the heat, pressure and shear are applied in an extrusion process.

94. A method of forming a composite material which comprises:

providing a quantity of first particles of a binder material, said first particle having diameters between about 0.1 and about 150 micrometers;

providing a quantity of second particles of a primary material having a softening temperature substantially greater than the softening temperatureof said binder material, said second particles having diameters between about 0.1 and about 3,000 micrometers;

combining the first and second quantities of particles in a *substantially uniform mixture* wherein said binder material is present in an amount of at least about 3% by weight of the mixture;

heating said substantially uniform mixture, *in the absence of pressure or shear sufficient to convert the binder particles,* to a *temperature substantially above the softening temperature of said binder material but to a temperature less than the softening temperature of said primary material;*

thereafter applying *pressure and shear to the heated mixture sufficient to substantially immediately convert at least a portion of the binder material particles into a substantially continuous webbing structure or cause forced point-bonding of the particles of the primary material by the binder material;* and

substantially immediately after formation of said binder particles into a webbing structure or forced point-bonds, rapidly cooling said mixture to below the melting point of the binder material to retain said converted binder material in its continuous webbing structure or forced point-bonded condition to produce the composite material.

2. *The '722 Patent*

The '722 patent is entitled "Process for the Production of Materials and Materials Produced by the Process." The '722 patent is directed to producing a composite porous article containing primary particles and binder particles which have a lower softening temperature than the primary particles. The patent discloses a composite article in which the primary particles form a matrix that is supported and held in place by the binder particles. The primary particle matrix is replete with pores and voids, which are partially filled by the binder material. Claim 1 of the '722 patent describes the binder particles as forming "a substantially continuous thermoplastic binder phase supporting and enmeshing" the primary particles. Claim 77 of the '722 patent describes the binder as forming "forced point-bonds between the primary particles[.]"

a. *Prosecution History*

On January 25, 1990, Koslow filed the application which led to the '722 patent, known as Application Serial

No. 07/571,075. Koslow filed it as a divisional application of the co-pending application which led to the '311 patent.

On May 3, 1991, the PTO issued an office action rejecting claims 87-165, 182-191, and 206 and canceling claims 1-86, 166-182, 192-205, and 207. The examiner characterized the invention as "the concept of a plurality of primary particles and a matrix binder, the particles having a higher softening temperature than the binder." He rejected the pending claims as unpatentable over the admitted prior art in view of the Stastny (U.S.Patent No. 2,865,800), Stayner (U.S.Patent No. 3,608,010), Shannon '341 (U.S.Patent No. 3,325,341) and Olcott et al. (U.S.Patent No. 4,180,211) patents.

On August 29, 1991, Koslow filed a response, arguing that the examiner had grossly over-simplified "the novel products produced by applicant's process." Koslow argued the application discloses other characteristics not disclosed in the cited prior art references which are "the result of following applicant's process of applying a specified pressure to the heated mixture, followed by rapid cooling." On January 10, 1992, the PTO issued a final rejection of all pending claims as unpatentable again over the admitted prior art in view of the Stastny, Stayner, Shannon '341 and Olcott et al. patents. According to the examiner,

the instant claims call for the concept of a plurality of primary particles and a matrix binder, the particles having a higher softening temperature than the binder. This would, in any case, be basically simple and obvious so as not to destroy the particles as particles. Apparently this concept is old in the admitted prior art....

On February 27, 1992, Koslow submitted an amendment and request for reconsideration. Koslow canceled claims 88 and 94, and amended claims 87 and 183. Claim 87 appears as the '722 patent's claim 1 and claim 183 appears as the '722 patent's claim 77.

Koslow amended claim 87 as follows:

A porous FN1 composite [composition of matter] FN2 article comprising:

FN1. Underlined text denotes text added to the amended claim.

FN2. Bracketed text indicates text deleted from the amended claim.

a plurality of primary particles having relatively high softening temperatures, said particles having a diameter between about 0.1 and about 3000 micrometers; and
a matrix of from 3 to 30% by weight of a substantially continuous thermoplastic binder phase [material] supporting and enmeshing said primary articles, said continuous binder phase being formed from binder particles having a diameter of between about 0.1 to about 150 micrometers, said [a] binder particles [material] being substantially incapable of fibrillation under normal conditions into micro fibers of less than 10 micrometers diameter at room temperature and having a softening temperature substantially below the softening temperature of the primary particles,

and where such primary particles are consolidated into a [high density and] uniform matrix with the continuous binder material present as a dilute material within the pores between the primary particles, the

remainder of the pore volume comprising a continuous [or discontinuous] volume of voids and said binder material being forced into macropores and exterior voids of individual primary particles having such macropores and exterior voids.

Koslow amended claim 183 as follows:
A porous composite articleFN3 [composition of matter] FN4 comprising:

FN3. Underlined text denotes text added to the amended claim.

FN4. Bracketed text denote text deleted from the amended claim.

a plurality of primary particles having relatively high softening temperatures, said particles having a diameter between 0.1 and 3000 micrometers; and
a matrix of from 3 to 30% by weight of a thermoplastic binder material having a softening temperature substantially below the softening temperature of the primary particles, said matrix being formed from binder particles having a diameter of from about 0.1 to about 150 micrometers;

wherein the primary particles are consolidated into a [high density] uniform matrix with melted and resolidified binder matrix present as forced point-bonds between the primary particles, wherein binder material is forced into macropores and exterior voids of individual primary particles to form physical connections between particles having such macropores and exterior voids.

In distinguishing the application from the prior art, Koslow argued his "invention employs a novel process ... to produce novel porous composite articles which are characterized by a three-phase structure, primary particles, binder and gas...."

On March 23, 1992, the PTO issued a notice of allowability, allowing the '722 patent application's claims 87, 89-93, 95-164, 183-191, 206, and 208. The '722 patent issued on September 15, 1992. Koslow assigned the patent to Koslow Technologies Corporation.

b. *Terms in Dispute*

KXI claims Culligan has infringed claims 33 and 81 of the '722 patent. Claim 33 is dependent on claim 1, and claim 81 is dependent on claim 77. These claims read as follows, with disputed terms and phrases in italics.

1. A *porous composite article* comprising:

a plurality of primary particles having relatively high softening temperatures, said particles having a diameter between about 0.1 and about 3000 micrometers; and

a matrix from 3 to 30% by weight of a substantially continuous thermoplastic binder phase supporting and enmeshing said primary particles, said continuous binder phase being formed from binder particles having a diameter of between about 0.1 to about 150 micrometers, said binder particles being *substantially incapable of fibrillation under normal conditions into micro fibers of less than 10 micrometers diameter at room*

temperature and having a softening temperature substantially below the softening temperature of the primary particles,

and where such *primary particles are consolidated into a uniform matrix with the continuous binder material present as a dilute material within the pores between the primary particles,* the remainder of the pore volume comprising a continuous volume of voids and said binder material being forced into macropores and exterior voids of individual primary particles having such macropores and exterior voids.

33. The composition of claim 1 wherein the binder material forming the matrix is a crystalline thermoplastic polymer selected from the group consisting of polyolefins, polyvinyls, polyvinyl esters, polyvinyl ethers, polyvinyl sulfates, polyvinyl phosphates, polyvinyl amines, polyxidiazoles, polytriazols, polycarbodiimides, ethylene-vinyl acetate copolymers, polysulfones, polycarbonates, polyethers, polyarylene oxides, and polyesters.

77. A *porous composite article* comprising:

a plurality of primary particles having relatively high softening temperatures, said particles having a diameter between 0.1 and 3000 micrometers; and

a matrix of from 3 to 30% by weight of a thermoplastic binder material having a softening temperature substantially below the softening temperature of the primary particles, said matrix being formed from binder particles having a diameter of from about 0.1 to about 150 micrometers;

wherein the primary particles are consolidated into a uniform matrix with melted and resolidified binder matrix present as forced point-bonds between the primary particles, wherein binder material is forced into macropores and exterior voids of individual primary particles to form physical connections between particles having such macropores and exterior voids.

81. The composition of claim 77 wherein the primary particles are granular or powdered carbon.

3. ***The*** '092 Patent

The '092 patent is entitled "Method and Apparatus for the Continuous Extrusion of Solid Articles." It discloses a method and apparatus for making composite solid articles from feed mixtures comprised of a "substantially uniform mixture" of primary particles and binder particles which have a softening temperature below that of the primary particles. The feed mixture is a solid material in powdered form.

Claim 1 of the '092 patent discloses an extruder apparatus capable of extruding solid composite materials. This extruder consists of an extruder barrel connected to an extrusion die. The feed mixture is fed into one end of the extruder barrel. The extruder barrel houses an extrusion screw. As it turns, the screw forces the mixture forward into the extrusion die. The material is heated in the extrusion die, and then pushed through the die and formed into a shape. Claim 1 teaches that back-pressure is applied to the material as the material is pushed out of the die, and tht this back-pressure is from a source external to the die. The material is then cooled until it forms a solid. Claims 2-11 are dependent claims, offering modifications of the method described in claim 1.

a. ***Prosecution History***

On April 8, 1991, Koslow filed the application which led to the '092 patent, known as Application Serial No. 07/682,182. As originally filed, the application included the claims that would make up the "8 patent as well as the claims of the '092 patent.

On August 23, 1991, the PTO issued an office action rejecting all of the application's twenty-two claims as unpatentable over the prior art of the Breton et al. patent (U.S.Patent No. 4,194,090). The Breton et al. patent discloses a process and an article of manufacture composed of polytetrafluroethylene and another particulate material. The PTO also rejected claims 1-22 for double patenting, finding these claims disclose the same invention as the '311 patent's claims 1-118.

On September 20, 1991, Koslow amended his application and requested reconsideration. Koslow argued there was no double-patenting with respect to claims 13-16, because these claims are directed to an extrusion apparatus, and the '311 patent's claims are method claims, directed to forming composite material. Also, Koslow argued there was no double-patenting with respect to claims 1-12 because these claims are directed to a method of extruding a solid composite material not disclosed by the '311 patent. According to Koslow, the '092 patent's extrusion method claims teach "(1) extruding a substantially uniform mixture (of the binder particles and primary material particles) into a *die of substantially uniform cross-section;* and (2) applying sufficient *back pressure, from without the die,* to the heated mixture." Koslow argued these process steps are different from the '311 patent's process steps for forming extruded composite material.

Koslow distinguished the Breton et al. patent by arguing that it does not refer to articles made by extrusion. Moreover, Koslow argued, the Breton process involves "cold compression ... utilizing pressures of 50,000 to 200,000 psi or higher[.]" He argued that the invention in the application does not use cold compression or pressures this high.

On December 11, 1991, the PTO issued a final action, allowing claims 1-12, and rejecting claims 13-22. On February 25, 1992, Koslow requested reconsideration of claims 13-22.

On June 11, 1992, the PTO issued an advisory office action, again rejecting claims 13-22. On May 26, 1992, Koslow filed a supplemental amendment, requesting the PTO cancel claims 13-22 without prejudice. Koslow also amended claim 1 by inserting in line 15 the term "from an extruder barrel" after the word "mixture" and inserting in line 10 the phrase "which cross-section is not substantially smaller than the cross-section of the inside diameter of the extruder barrel" after "cross-section[.]" The '092 patent issued on February 23, 1993. Koslow assigned the patent to Koslow Technologies Corporation.

b. *Terms in Dispute*

KXI claims Culligan has infringed claims 2 and 3 of the '092 patent. Both claims 2 and 3 are dependent on claim 1. These claims read as follows, with disputed terms and phrases in italics.

1. A method of extruding a solid composite material which comprises:

providing a quantity of first particles of a binder material, said first particles having diameters between about 0.1 and about 250 micrometers;

providing a quantity of second particles of a primary material having a softening temperature substantially greater than the softening temperature of said binder material, said second particles having diameters

between about 0.1 and about 3,000 micrometers;

combining the first and second quantities of particles in a *substantially uniform mixture wherein said binder material is present in a amount of at least about 3% by weight of the mixture;*

extruding said substantially uniform mixture from an *extruder barrel into a die of substantially uniform cross-section which cross-section is not substantially smaller than the cross-section of the inside diameter of the extruder barrel;*

heating said substantially uniform mixture within said die to a temperature substantially above the softening temperature of said binder material but to a temperature less than the softening temperature of said primary material;

applying sufficient back pressure, from without said die, to the heated mixture within said die to convert said heater mixture into a substantially homogeneous composite material;

rapidly cooling said composite material to below the softening point of the binder material to produce the composite material; and

extruding said composite material from said die as an extruded solid composite material product.

2. The method of claim 1 wherein the back pressure is applied to the extruded solid composite material product.

3. The method of claim 1 wherein the back pressure applied to the heated mixture in the die cavity is a pressure of between about 5 and about 400 psi.

4. *The* "8 Patent

The "8 patent is entitled "Apparatus for the Continuous Extrusion of Solid Articles." It was originally filed as a continuation-in-part application of the '092 patent, and has the same specification. The patent claims an apparatus for extruding a solid composite porous article from a solid, powdered feed mixture composed of a "substantially uniform mixture" of particulate primary material and particulate binder material.

The "8 patent discloses an extruder apparatus. The patent specification includes figures 1-4, which are diagrams of an example of an extruder. The same figures are included in the '092 patent specification. Figures 1 and 3 from the "8 patent are reproduced below.

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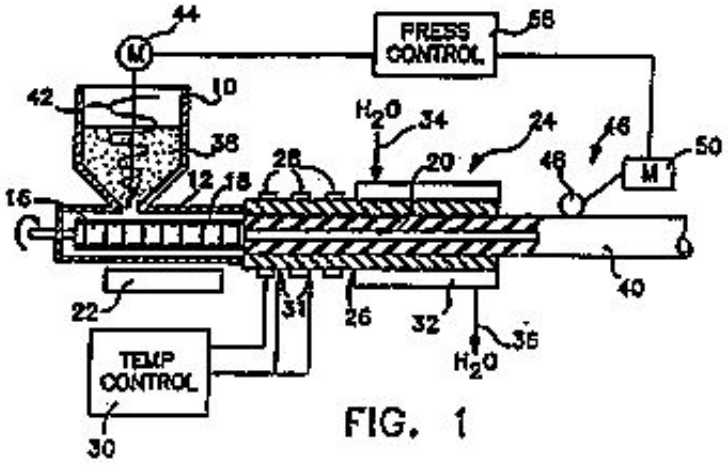

FIG. 1

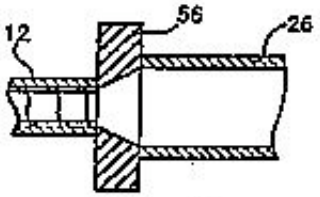

FIG. 3

This example extruder depicted in figures 1 and 3 has a feed bin (10) which contains the food mixture. The example extruder has an extruder barrel (12) housing an extrusion screw (14), which is comprised of a solid core (16) surrounded by helical flights (18). The particulate material is fed from the feed bin (10) into the extruder barrel (12). It is then pushed through the barrel (12) by the extrusion screw (14) and into a die assembly (24) which contains a die (26). The diagram depicts heating elements (28) at the input end of the die.

Claim 1 discloses "an elongated, smooth extrusion die" attached to the extruder barrel's feed outlet. The die has an inlet end attached to the feed outlet, and an extrusion end. The die must have "a substantially uniform cross-section, which cross section is not substantially smaller than the cross-section of an inside diameter of the extruder barrel." Claim 1 discloses the apparatus must have "means for forcibly injecting" the mixture into the inlet end of the die cavity, as well as means in the die "adjacent to the inlet end" for heating the mixture "to a temperature substantially above the softening temperature" of the binder material, but less than the primary material's softening temperature. Claim 1 discloses there must be means external to the die cavity for applying pressure to the heated mixture "within the die cavity during extrusion[,]" and means for "rapidly cooling" the "mixture within the die cavity" to below the binder material's softening temperature.

Claims 2-6 are dependent claims, disclosing modifications to the mechanism disclosed in claim 1. Claim 2 discloses using a back-pressure force as the means for applying pressure to the extruded material.

a. *Prosecution History*

On October 17, 1991, Koslow filed the application which led to the "8 patent as a continuation-in-part

application of the co-pending application which led to the '092 patent. It was known as Application Serial No. 07/778,266. Claims 1-8 and 12-19 of the application were the same as claims 1-8 and 11-18, respectively, of the application which led to the '092 patent.

On April 28, 1992, the PTO issued an office action requiring Koslow to restrict the application to one of four inventions embodied in the claims: claims 1-13, drawn to a method; claims 14-17, drawn to an apparatus; claims 18-24, drawn to an article, or claims 25-31, drawn to a composition. On May 7, 1992, Koslow elected to prosecute apparatus claims 14-17.

On July 6, 1992, the PTO issued an office action, rejecting claims 14-17 as unpatentable over the Leitl patent in view of the Zavasnik patent. The examiner described the Leitl patent's invention as follows:

Leitl discloses an extrusion apparatus comprising an extruder barrel (3) housing an extrusion screw (2), an extrusion die (41b) at the outlet end of the extrusion barrel and having a uniform cross section larger than that of the barrel, said screw forcibly injecting the material into the inlet end of the die cavity and means (43) external of the die cavity for applying a back pressuring force on the extruding material.

The numbers in parentheses correspond to the reference numbers on the figures accompanying the patent.

The PTO described the Zavasnik patent's invention as follows:

Zavasnik discloses an extrusion apparatus similar to that of Leitl, wherein the die is heated and cooled such that the extrudate is prevented from prematurely freezing in the die, but is allowed to solidify at the outlet end of the enlarging cross section die, said extrudate undergoing back pressurization by means of a movable resilient annular member (18).

The examiner found that both the Leitl and the Zavasnik patents disclose extruders with back-pressuring means external to the dies. The examiner found the "8 patent application obvious in light of the prior art of the Leitl and Zavasnik patents. According to the examiner, it would have been obvious to one skilled in the art at the time of the invention to modify the extruder disclosed in the Leitl patent to include heating and cooling means within the die, as the "8 patent's inventors did, so that the extruder could be used with a wider range of materials.

On October 2, 1992, Koslow amended his application and requested reconsideration. Koslow canceled claims 1-13 and amended claim 14 as follows:

14. Apparatus [for] FN5 capable ofFN6 the continuous extrusion manufacture of a solid composite [material] article from a substantially uniform particulate mixture of a quantity of particles of a binder material and a quantity of particles of a primary material, said primary material having a substantially higher softening temperature than [the] a softening temperature of said binder material, which comprises:

FN5. Bracketed text indicates text deleted from the amended claim.

FN6. Underlined text denotes text added to the amended claim.

an extruder barrel housing an extrusion screw, said extruder barrel having a feed inlet and feed outlet;
an extrusion die attached to the feed outlet of the extruder barrel, said die defining a cavity having an inlet end, an extrusion end, and a substantially uniform cross-section, which cross-section is not substantially smaller than the cross-section of an inside diameter of the extruder barrel;

means for forcibly injecting said particulate mixture into the inlet end of said die cavity;

means for heating said particulate mixture within said die cavity to a temperature substantially above the softening temperature of said binder material but less than the softening temperature of said primary material;

means external of said die cavity for providing pressure of between about 5 to about 400 psi to said heated particulate mixture within the die cavity during extrusion of the particulate mixture [to a pressure between about 5 to about 400 psi]; and

means for rapidly cooling said particulate mixture within the die cavity to below the softening [point] temperature of the binder material to form a monolithic solid composite material whereby said solid composite material is extruded from said die cavity as a solid composite article.

Koslow also added new claims 32 and 33.
Koslow argued that the prior art references cited by the examiner disclose extruders designed to extrude liquid or fluidized feed compositions. Koslow distinguished the application which led to the "8 patent from the Leitl and Zavasnik patents by arguing the application discloses an extruder designed to extrude solid particulate feed mixtures. According to Koslow, the extruder die disclosed by the Leitl patent is tapered, meaning "progressively reduced in diameter" and as such, is "totally unsuitable and unable to extrude solid particulate material into a solid composite article."

Koslow distinguished the Zavasnik patent based upon design differences. According to Koslow, the application which led to the "8 patent discloses cooling the mixture of heated primary material and binder material mixture in the extrusion die itself. Koslow argued "deformation, consolidation, and solidification of the particulate material" all occur in the die cavity. In contrast, Koslow argued, "the extruder disclosed in the Zavasnik patent includes a thermal barrier between the cooling liquid and the extrusion die [,]" and, as a result, the extruded material is only cooled "after leaving the extrusion forming die."

Koslow also argued the extruder disclosed in the Zavasnik patent employs a different structure from the extruder described in the application which led to the "8 patent. According to Koslow, the forming die taught in the Zavasnik patent "must be of increasing cross-sectional area" whereas the extrusion die disclosed in the application has a "substantially uniform cross-section."

On December 30, 1992, the PTO issued a final rejection, rejecting claims 14-17, 32, and 33 as being unpatentable over the Leitl patent taken together with the Zavasnik patent. The examiner found it would have been obvious to one skilled in the art at the time of the invention to modify the die of the extruder disclosed in the Leitl patent to include both heating and cooling means within the die, thus allowing the extruder to be used with a wide range of materials.

The examiner rejected Koslow's contention that the Zavasnik patent does not disclose a die cavity in which the extrusion material is both heated and cooled. Referring to the extruder disclosed in the Zavasnik patent,

the examiner found "the extrusion die (26) is clearly heated at its inlet end by its close proximity to the heated extruder barrel (11), and secondly, the die is cooled at its extrusion end by cooling water within the passage (33)." The numbers in parentheses correspond to the reference numbers on the figures accompanying the patent. Figures 1 and 3 are reproduced below.

***475**

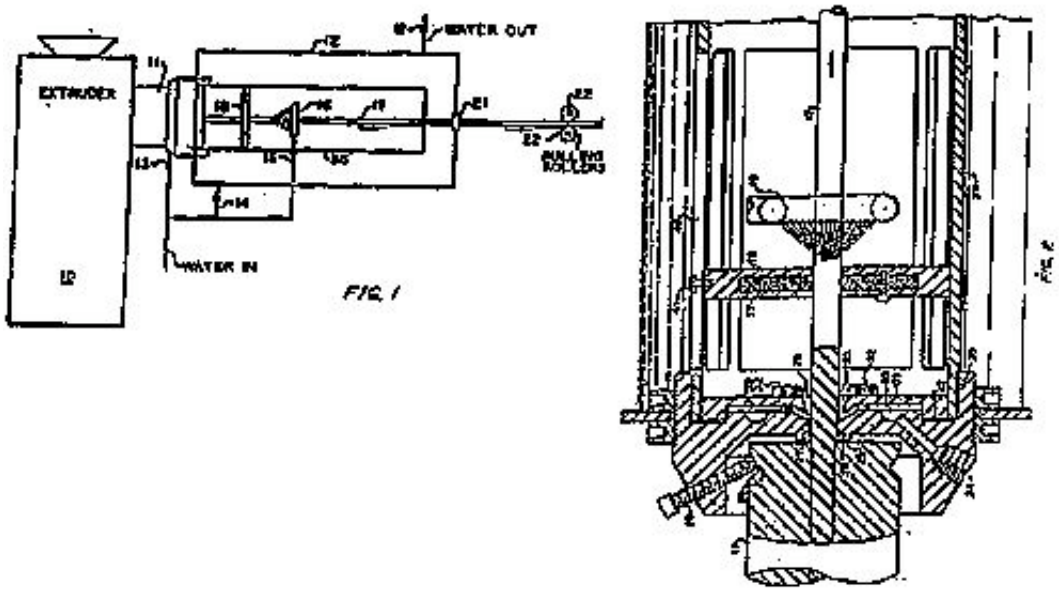

FIG. 1

On March 10, 1993, Koslow amended the "8 patent application and requested reconsideration. Koslow amended claim 14 as follows:

14. Apparatus capable of the continuous extrusion manufacture of a solid composite porousFN7 article from a substantially uniform particulate mixture of a quantity of particles of a binder material and a quantity of particles of a primary material, said primary material having a substantially higher softening temperature than a softening temperature of said binder material, which comprises:

FN7. Underlined text denotes text added to the amended claim.

an extruder barrel housing an extrusion screw, said extruder barrel having a feed inlet and feed outlet;
an elongated, smooth extrusion die attached to the feed outlet of the extruder barrel, said die defining a cavity having an inlet end, an extrusion end, and a substantially uniform cross-section, which cross-section is not substantially smaller than the cross-section of an inside diameter of the extruder barrel;

means for forcibly injecting said particulate mixture into the inlet end of said die cavity;

means in said die adjacent to the inlet end thereof for heating said particulate mixture within said die cavity

to a temperature substantially above the softening temperature of said binder material but less than the softening temperature of said primary material;

means external of said die cavity for continuously providing controlled pressure of between about 5 to about 400 psi to said heated particulate mixture within the die cavity during extrusion of the particulate mixture; and

means in said die adjacent to the extrusion end thereof for rapidly cooling said particulate mixture within the die cavity to below the softening temperature of the binder material to form a monolithic solid composite material whereby said [solid composite material] FN8 substantially uniform particulate mixture is deformed,*476 consolidated into a desired form and solidified in the extrusion die and is extruded from said die cavity as a solid composite porous article.

FN8. Bracketed text indicates text deleted from the amended claim.

Koslow repeated his arguments that the Leitl and Zavasnik patents disclose extruders for liquid or fluidized compositions which could not extrude solid particulate mixtures. With respect to the Leitl patent, Koslow argued that the tapered nozzle disclosed is incapable of "extruding (deforming and shaping)" a solid particulate mixture. Furthermore, Koslow argued, the Leitl patent discloses no means for heating or cooling the material in the extrusion die cavity.

Koslow argued that the extruder disclosed in the Zavasnik patent has a structure different from the extruder disclosed in the application, and is not capable of extruding solid particulate feed mixtures. Koslow pointed out that the patent disclosed cooling the extruded material after it leaves the "extrusion forming die." Koslow argued that by contrast, in the present invention the extruded material is cooled in the extrusion die.

Koslow pointed out that the extruder disclosed in the Zavasnik patent contains a thermal barrier between the "cooling liquid and the extrusion die," and that therefore, solidification of the molten thermoplastic does not occur in the extrusion die. Koslow argued that, in contrast, the application discloses a method for consolidating and solidifying particulate material in the die cavity itself. Koslow pointed out that the Zavasnik patent discloses heating the particulate material in the "extruder barrel (11)" not in the "forming die (26)" and discloses "the extruder is distinct and apart from [the] forming die." Koslow argued "[i]n contrast, the non-heated extruder barrel in the present invention is merely a means for conveying the particulate mixture into the extrusion die."

Koslow argued that the examiner's finding that the extruder disclosed in the Zavasnik patent has heating and cooling mechanisms in the same die is clearly erroneous. In support, Koslow argued there is a "thermal barrier (25)" separating the "extrusion die (11)" from the "forming die (26)," and that there are not both heating and cooling means within the cavity of either die. According to Koslow, "the mere fact that forming die (26) is in 'close proximity to' extrusion die (11), as contended by the PTO would not permit heating necessary to occur within the forming die (26), particularly in view of the thermal barrier (25) between the two dies."

Koslow also pointed out design differences between the "8 patent invention and the extruder disclosed in the Zavasnik patent. He argued that while the forming die "(26)" disclosed by Zavasnik must be of "increasing cross-sectional area," the extrusion die disclosed in the application has a "substantially uniform cross-

section."

On March 11, 1993, the PTO allowed claims 14-17, 32 and 33, and renumbered them as claims 1-6, respectively. The PTO issued the acceptance contingent upon the cancellation of claims 18-31. The "8 patent issued on October 5, 1993. Koslow assigned the patent to Koslow Technologies Corporation.

b. *Terms in Dispute*

KXI claims Culligan has infringed claim 2 of the "8 patent. Claim 2 is dependent upon claim 1. These claims read as follows, with disputed terms and phrases in italics.

1. *Apparatus capable of the continuous extrusion manufacture of a solid composite porous article from a substantially uniform particulate mixture of a quantity of particles of a binder material and a quantity of particles of a primary material,* said primary material having a substantially higher softening temperature than a softening temperature of said binder material, which comprises:

an extruder barrel housing an extrusion screw, said extruder barrel having a feed inlet and feed outlet;

an elongated smooth extrusion die attached to the feed outlet of the extruderbarrel, said die defining a cavity having an inlet end, an extrusion end, and a substantially uniform cross-section, which cross-section is not substantially smaller than the cross-section of an inside diameter of the extruder barrel;

means for forcibly injecting said particulate mixture into the inlet end of said die cavity;

means in said die adjacent to the inlet end thereof for heating said particulate mixture within said die cavity to a temperature substantially above the softening temperature of said binder material but less than the softening temperature of said primary material;

means external of said die cavity for continuously providing controlled pressure of between about 5 to about 400 psi to said heated particulate mixture within the die cavity during extrusion of the particulate mixture; and

means in said die adjacent the extrusion end thereof for rapidly cooling said particulate mixture within the die cavity to below the softening temperature of the binder material to form a monolithic solid composite material *whereby said substantially uniform particulate mixture is deformed, consolidated into a desired form and solidified in the extrusion die and is extruded from said die cavity as a solid composite porous article*.

2. The apparatus of claim 1 wherein the means for pressurizing comprises means for applying a back-pressuring force to the extruding solid composite material.

II. *DISCUSSION*

A. *What is the Legal Standard Under Which a Court Should Construe the Claims of a Patent?*

[1] [2] [3] [4] Claim construction is a matter for the court. Markman v. Westview Instruments, Inc., 52 F.3d 967, 979 (Fed.Cir.1995) (*en banc*), *aff'd,* 517 U.S. 370, 116 S.Ct. 1384, 134 L.Ed.2d 577 (1996). Claims are construed from the vantage point of a person of ordinary skill in the art at the time of the invention. Id.

at 986. In construing a claim, a court looks first to the intrinsic evidence of record, namely, the language of the claim, the specification, and the prosecution history. Insituform Tech. Inc. v. Cat Contracting, Inc., 99 F.3d 1098, 1105 (Fed.Cir.1996), *cert. denied,* 520 U.S. 1198, 117 S.Ct. 1555, 137 L.Ed.2d 703 (1997). The claim language itself defines the scope of the claim, and "a construing court does not accord the specification, prosecution history, and other relevant evidence the same weight as the claims themselves, but consults these sources to give the necessary context to the claim language." Eastman Kodak Co. v. Goodyear Tire & Rubber Co., 114 F.3d 1547, 1552 (Fed.Cir.1997).

[5] Although extrinsic evidence such as expert testimony may be considered if needed to assist the court in understanding the technology at issue or in determining the meaning or scope of technical terms in a claim, Hoechst Celanese Corp. v. BP Chems. Ltd., 78 F.3d 1575, 1579 (Fed.Cir.), *cert. denied,* 519 U.S. 911, 117 S.Ct. 275, 136 L.Ed.2d 198 (1996), reliance on any extrinsic evidence is improper where the public record, *i.e.,* the claims, specification, and file history, unambiguously defines the scope of the claims. Vitronics Corp. v. Conceptronic, Inc., 90 F.3d 1576, 1583 (Fed.Cir.1996).

[6] While the Court of Appeals for the Federal Circuit has held that claims should be read in view of the specification, *see, e.g.,* id. at 1582, the court has repeatedly cautioned against limiting the scope of a claim to the preferred embodiment or specific examples disclosed in the specification. *See, e.g.,* Ekchian v. Home Depot, Inc., 104 F.3d 1299, 1303 (Fed.Cir.1997); *see also* Intervet America, Inc. v. Kee-Vet Laboratories, Inc., 887 F.2d 1050, 1053 (Fed.Cir.1989) ("[L]imitations appearing in the specification will not be read into claims, and ... interpreting what is meant by a word in a claim 'is not to be confused with adding an extraneous limitation appearing in the specification which is improper.' ") (citations omitted).

[7] [8] There is presumed to be "a difference in meaning and scope when different words or phrases are used in separate claims." United States v. Telectronics, Inc., 857 F.2d 778, 783 (Fed.Cir.1988), *cert. denied,* 490 U.S. 1046, 109 S.Ct. 1954, 104 L.Ed.2d 423 (1989). Under the doctrine of "claim differentiation," a presumption exists against construing claims as so similar as to "make a claim superfluous." *Id.*

Federal patent law permits claims in a patent to be written in "means-plus-function" language. 35 U.S.C. s. 112(6). The statute provides that "[a]n element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof." The statute also provides that if a claim is written in a means-plus-function language, the court shall construe the claim to "cover the corresponding structure, material, or acts described in the specification and equivalents thereof." *Id.* That is, the court will treat the terms "means" as a "generic reference [to] the corresponding structure disclosed in the specification." Chiuminatta Concrete Concepts, Inc. v. Cardinal Indus., Inc., 145 F.3d 1303, 1308 (Fed.Cir.1998).

[9] If an element contains the word "means," the court will presume the inventor used the term "to invoke the statutory mandates for means-plus-function clauses." Sage Products, Inc. v. Devon Indus., Inc., 126 F.3d 1420, 1426 (Fed.Cir.1997) (citations omitted). However, that presumption is not conclusive. *See id.* A claim that uses the word "means," but does not specify a corresponding function, will not invoke section 112. *See, e.g.,* York Products, Inc. v. Central Tractor Farm & Family Center, 99 F.3d 1568, 1574 (Fed.Cir.1996) (finding that the word "means" in a claim does not invoke section 112, paragraph 6, because the claim "does not link the term 'means' to a function," but instead recites structure).

B. *Disputed Terms and Phrases in the '092 and* "8 Patents

1. *What is the Proper Construction of the Phrase "substantially uniform mixture" in* the '092 patent *and "substantially uniform particulate mixture" in* the "8 patent*?*

[10] Claim 1 of the '092 patent contains the phrase "particles in a substantially uniform mixture" to describe the feed mixture composed of primary particles and binder particles. Claim 1 of the "8 patent contains the phrase "substantially uniform particulate mixture" to describe the feed mixture composed of primary particles and binder particles. KXI contends the words should be given their ordinary meaning, and that these phrases refer to a largely-but not necessarily wholly-even distribution of particles. KXI contends there are no other mixing requirements and no special methods of mixing required. The test for proper mixing, according to KXI, is stated in the '092 patent's specification at column 8, lines 7-14 and the "8 patent's specification at column 8, lines 13-19:

An experienced operator can also readily notice a reduction in the flow characteristics of the powder mixture that indicates the formation of the desired bonds between particles. Samples smeared on a black surface show no residual binder aggregates which would be indicated by the presence of small white streaks.

Culligan argues that the specifications of the '092 and "8 patents define the terms "substantially uniform mixture" and "substantially uniform particulate mixture" in a special way. According to Culligan, "substantially uniform" is a limitation requiring the formation of stable attachments betweenthe primary particles and binder particles. Culligan argues that the claim requires vigorous mixing until stable "prebonds" or "microaggregates" are formed between the primary particles and binder particles throughout the mixture. Culligan points to provisions of the specifications reading:

Correct methods of mixing produce a material composed of microaggregates of primary particles and binder particles .... Poorly mixed materials, or use of binder or primary particles lacking the ability to form stable "prebonds" results in mixtures where binder and primary particles separate, or where primary particles of widely varying density or morphology separate because stable aggregates have not been formed. It is these stable aggregates, formed during mixing that allow this process to bond particles that cannot normally be maintained in a stable mixture. It appears that, as a rule, the process is generally not workable with poorly mixed materials or with materials in which the binder particles have not become attached to the primary particles during the mixing step.

Culligan argues that here the '092 and "8 patents' specifications tell a person knowledgeable in the art that they must mix the primary and binder particles in a certain way to practice the invention; so as to create stable "prebonds" or "microaggregates."

The Federal Circuit has held that "[t]he specification acts as a dictionary when it expressly defines terms used in the claims or when it defines terms by implication." Vitronics Corp. v. Conceptronic, Inc., 90 F.3d 1576, 1582 (Fed.Cir.1996). Culligan argues that the specifications of the "8 and '092 patents expressly defines the phrase "substantially uniform." KXI argues in response that it is only appropriate to give a term a special meaning where "the special definition of the term is clearly stated in the patent specification or file history." Id. at 1582.

The court agrees with KXI that the patentee did not give special meaning to the phrase "substantially uniform mixture" or "substantially uniform particulate mixture" in the '092 and "8 patent's specifications The court construes the words "substantially uniform particulate mixture" and "substantially uniform mixture" according to their ordinary meaning. Accordingly, the court construes the phrases "substantially

uniform mixture" and "substantially uniform particulate mixture" as meaning a largely-but not wholly-even distribution of particles.

2. *What is the Proper Construction of the Terms "barrel" and "die" in the '092 and* "8 Patents*?*

[11] Claim 1 of the '092 patent and claim 1 of the "8 patent contain the terms "extruder barrel" and "die." KXI and Culligan dispute where the "extruder barrel" ends and the "die" begins. KXI contends in both patents the "extruder barrel" and "die" are co-joined tubes, the "extruder barrel" the part that houses the extrusion screw, and the "die" the part that does not house the extrusion screw. Essentially, KXI's position is that the die begins where the helical flights of the extrusion screw end. Culligan contends in both patents the "die" is a distinct structure from the "barrel." Culligan contends the "die" is the structure that imparts shape and form to the feed mixture, and the "barrel" is the structure that houses the feed screw.

In support of its construction, KXI cites column 3, lines 2-5, 19-20, and 35-42 of the '092 patent, and column 3, lines 8-11, 25-26, and 41-48 of the "8 patent. Here, the specifications state:

The feed bin 10 feeds into an extruder barrel 12 which contains a feed screw 14. The feed screw 14 comprises a solid core 16 surrounded by conventional helical flights 18 .... The output end of the extruder barrel 12 feeds the input end of a die assembly 24....

KXI argues this passage defines the term "extruder barrel" as the structure containing the feed screw.

In support of its construction, KXI cites a 1996 letter written by Joseph Jochman, Esq. to Plymouth. Jochman was Plymouth's outside patent counsel at the time. The letter concerned changes Plymouth contemplated making to its carbon block extruder. Plymouth had contemplated removing flights from the extrusion screw. Jochman stated "the removal of a few downstream flights from the extruder screw would result in a de facto extension in the upstream direction of the die cavity. In other words, the flightless part of the extruder barrel in effect becomes part of the die." KXI argues the Jochman letter is extrinsic evidence, and should be considered to show that Culligan, through its patent counsel, agrees with KXI's interpretation of the terms "extruder barrel" and "die."

In support of its construction, Culligan cites figures 1 and 3 accompanying the "8 and '092 patents, reproduced *supra*. These figures depict the extruder, including the extruder barrel, referred to as "12," and the die, referred to as "26." Culligan argues that the figures depict the extruder barrel (12), and the die (26), as two separate tubular structures. Culligan argues the separate structures are distinguished by the beginning and end of their respective tubes, and not by the ends of the extrusion screw's flights. Culligan argues the position of the "input end of the die" as depicted in the figures accompanying the "8 and '092 patents is downstream from the expansion flange (56) and well downstream from the points where the flights on the feed screw terminate in the barrel (12).

Culligan argues KXI's definitions of the terms "extruder barrel" and "die" are inconsistent with the "8 and '092 patents' specifications. According to Culligan, the patents describe the extruder barrel and die as two structures, and do not define either one by the extrusion screw. Culligan cites the '092 patent at column 3, line 2-5 and the "8 patent at column 3, lines 8-11, which state that the extruder barrel "contains a feed screw 14" and that the feed screw "comprises a solid core (16) surrounded by conventional helical flights 18." Culligan cites the '092 patent's specification at column 3, lines 25-26 and the "8 patent's specification at column 3, lines 31-32, which state that "[t]he input end of the die 26 is provided with heating elements

28[.]"

Culligan argues that KXI's interpretation of the meaning of the terms "extruder barrel" and "die" is not supported by the prosecution history. During the prosecution of the "8 patent, the application was rejected over the prior art Zavasnik extruder, which does not contain a feed screw. Culligan points out that both the patentee and the examiner described the Zavasnik extruder as having an "extruder barrel (11)" and an "extruder die (26)." Culligan argues this description "directly undercuts plaintiffs' current logic, which would define the entire Zavasnik extruder as a 'die' because no portion of the extruder tubes contains a screw."

KXI responded that Culligan's argument is based on a mistake. The Zavasnik patent includes figures that depict the invention, reproduced *supra*. The different parts of the invention are numbered in the figures. According to KXI, during prosecution of the "8 patent, the examiner called the structure denoted as "11" the "barrel," and the patentee called it the "die." KXI argued that throughout the prosecution, the patentee's position was that "11" represented the "die." According to KXI, however, the patentee accidentally adopted the examiner's terminology and called "11" the "barrel" "once, maybe twice" during the prosecution.

Culligan argues that KXI defines the terms at issue contrary to the common meaning of "die." As support for its position, Culligan cites the McGraw Hill Dictionary of Scientific and Technical terms which defines "die" as "[a] tool or mold used to impart shapes to, or to form impressions on, materials such as metals and ceramics." McGraw-Hill Dictionary of Scientific and Technical Terms (4th ed.1989).

The court finds there is no reason to define the term "extruder barrel" by where the extruder screw ends. The court gives the ordinary meaning to the terms. Accordingly, the court will construe "extruder barrel" and "die" as separate structures, the "extruder barrel" being the structure that houses the feed screw, and the "die" being the structure that imparts shape and form to the extrudate.

3. *What is the Proper Construction of the Phrase "substantially uniform cross-section" in the '092 and* "8 Patents*?*

[12] Claim 1 of the '092 patent and claim 1 of the "8 patent contain the phrase "a die of substantially uniform cross-section." KXI contends the term "substantially" means "at least a 10% change in size." KXI contends that as applied to the claim, the phrase "substantially uniform cross-section" means "the die should not change in diameter by more than 10%." Culligan contends the phrase "substantially uniform cross-section" in the '092 and "8 patents means the internal cross-section of the die must vary less than about 0.010 inch along the length of the die.

The contested phrase reads: "a substantially uniform cross-section, which cross-section is not substantially smaller than the cross-section of an inside diameter of the extruder barrel[.]" KXI contends the word "substantially" in the phrase "substantially uniform cross-section" should be defined consistently with the term "substantially" in the phrase "not substantially smaller than the cross-section of an inside diameter of the extruder barrel[.]"

KXI contends the phrase "not substantially smaller" is defined in the '092 and "8 patents' specifications. The relevant parts of the specifications read:

[T]here are distinct limitations on the ability to compress the material into a die smaller than the extruder.

However, it has been discovered that, if that is to be attempted ... the ratio of the cross-sectional area of the die mouth to the extruder output are should not be less than approximately 0.9.

KXI interprets this to mean that the cross-section of the die can be 10% smaller than the size of the cross-section of the barrel. KXI contends the term "substantially" as used both in "substantially smaller" and "substantially uniform cross-section" means up to a 10% change in size. Accordingly, KXI argues "a substantially uniform cross-section" means the die's diameter should not change by 10%. KXI cites a recent federal district court case in support of the proposition that "[s]ince the term 'substantially' is used twice in the claim, it cannot have more than one meaning." Atmel v. Information Storage Devices, Inc., 997 F.Supp. 1210, 1215 (N.D.Cal.1998).

Culligan responds that there is no reason to give the term "substantially" the same meaning in both phrases, as the term "substantially" is used fourteen times in claim 1 of the '092 patent and claim 1 of the "8 patent. Culligan also argues that *Atmel* does not support KXI's legal proposition. Instead, Culligan contends that *Atmel* holds that "[i]dentical or 'indisputably interchangeable' claim terms in patents that share a common ancestry should be construed consistently." *Id*. at 1215.

The court agrees with Culligan that there is no reason to construe "substantially" as having the same meaning in both phrases. The court finds the term "substantially" is used throughout claim 1 of both patents, and there is no indication that the patentee gave the term a uniform meaning.

Culligan contends the term "substantially uniform" was defined during the prosecution of the "8 patent to mean less than 0.010 inch. In both the October 2, 1992 Amendment and Request for Reconsideration and the March 10, 1993 Amendment and Request for Reconsideration, the "8 patentee distinguished the extruder disclosed in the Zavasnik patent based upon the "increasing cross-sectional area" of the forming die. The patentee stated: "the forming die in Zavasnik must be of increasing cross-sectional area-see column 2, line 59-65 and column 4, lines 22-24. In contrast, the extrusion die of the claimed invention is of substantially uniform cross-section."

The Zavasnik patent at column 2, lines 59-65 reads:

The cross-sectional dimensions of the forming die 26 at its entrance ... should be somewhat larger than that of the extruder crosshead die opening indicated at 52, e.g., about 0.01 to about 0.02 inch larger. The increase in die opening size will accommodate any expansion on the part of the plasticized thermoplastic material.

Culligan argues that when the patentee cited this section of the Zavasnik specification, he told the examiner that the Zavasnik extruder did not have a "substantially uniform" die because there is a variance of at least 0.010 inch. Culligan contends "by the time the patentee got its claims allowed, because this overcame the examiner's rejection, the patentee obviously believed that something which varied by 0.010 inch was not 'substantially uniform' in cross-section."

KXI responds that this Zavasnik reference is irrelevant because it does not describe a die which increases in cross-section over its length. KXI contends there are two dies disclosed in the Zavasnik patent; an extrusion die (11) and a forming die (26), and that these two dies are separated by an air gap. According to KXI, the Zavasnik patent at column 2, lines 59-64 requires that the opening of the forming die (26) be larger than the opening of extrusion die (11), to " 'receive' the extrudate after it crosses the air gap...." Therefore, KXI argues, 0.010 inch is not applicable to the change in diameter across the die.

The court agrees with KXI that the Zavasnik patent does not refer to an increasing cross-sectional diameter along the forming die, but to increase in the diameter of the opening of forming die (26) with respect to the extruder die (11). The court finds, however, that the patentee presented the 0.010 inch figure by reference during the prosecution of the "8 patent to distinguish the Zavasnik patent's prior art, and to represent the rate of variance in the die's cross section that is not "substantially uniform." Accordingly, the court construes the phrase "substantially uniform cross-section" in the "8 patent to mean less than a 0.010 inch variance in diameter along the length of the die.

The court also relies on the "8 patent's prosecution history as extrinsic evidence of the meaning of the phrase "substantially uniform cross-section" in the '092 patent. The court finds the term "substantially uniform cross-section" should be defined consistently in both patents as both patents use the exact same phrase to describe the same structure, and the "8 patent was originally filed as a continuation-in-part application of the application which led to the '092 patent. Accordingly, the court also construes the phrase "substantially uniform cross-section" in the '092 patent to mean less than a 0.010 inch variance in diameter along the length of the die.

4. ***What is the Proper Construction of the Phrase "means in said die ... for heating within said die" in*** the "8 Patent***?***

[13] Claim 1 of the "8 patent contains the phrase: "means in said die adjacent to the inlet end thereof for heating said particulate mixture within said die cavity to a temperature substantially above the softening temperature of said binder material but less than the softening temperature of said primary material." Both KXI and Culligan agree this is a means-plus-function element. KXI contends the "hot walls" of the die adjacent to the inlet end of the die are the claimed means that perform the heating function. KXI also contends: (1) nothing in the claim precludes heating from also occurring in the barrel, and (2) only a portion of the mixture must be heated to the required processing temperature in the die.

Culligan contends that heating elements (28) are the means that perform the heating function, and that heating elements (28) heat the entire mixture while the mixture is physically within the die. Culligan contends the claim limitation cannot be met by an extruder that heats the mixture solely by applying heat to the extruder barrel.

KXI argues that the phrase "means ... of heating" is defined at column 9, lines 5-11 of the "8 patent's specification. This reads:

In the first section of the die, *the walls of the die* are intensely heated to heat the feed mixture to a temperature substantially above (generally at least about 25 degrees Celsius above) the softening temperature of the binder material in the mixture but to a temperature less than the softening temperature of the primary material in the mixture. (Emphasis added).

Culligan contends the phrase "means ... of heating" is defined at column 3, lines 57-61 of the "8 patent's specification. Here, the specification states "the ... material ... passes into the die 26 where it is ... heated by heating elements 28 to the required processing temperature...." Culligan argues this construction is supported by the words of the claim. The claim requires the heating means be "adjacent to the inlet end of the die." Culligan contends the figures accompanying the patent depict heating elements (28) at the inlet end of the die.

KXI argues that Culligan's construction is wrong because heating elements (28) heat the die, not the mixture. KXI also argues Culligan's construction is wrong because it ignores the words of the claim. The phrase reads "means ... *in* said die" (emphasis added). KXI argues, however, heating elements (28) are located on the outside of the die, and not "in" the die. KXI relies on the figures accompanying the patent, which depict heating elements (28) on top of the die.

In response, Culligan argues that a literal interpretation of "in said die" to exclude heating means "on" said die would also exclude the means KXI has identified for heating the mixture, the "hot metal of the die itself." According to Culligan, "[t]he metal which forms the die cannot be said to be 'in' the die, i.e., in the die cavity, any more than a heating element which is 'on' the die."

Culligan argues that KXI's interpretation is contradicted by the prosecution history of the "8 patent. The PTO initially rejected the claims of the application which led to the "8 patent over the Zavasnik patent, which disclosed an extruder with heating elements in the barrel. In a December 30, 1992 final action, the examiner found "the extrusion die (26) [of Zavasnik] is clearly heated at its inlet end by its close proximity to the heated extruder barrel (11)...." The patentee then amended the application's claims to recite "means *in said die adjacent to the inlet end thereof* for heating said particulate mixture[,]" and argued as follows:

[I]n Zavasnik the heating of the plastic material occurs in the extruder barrel (11) not in the forming die (26) and the extruder is distinct and apart from the forming die. In contrast [to Zavasnik], in the apparatus of the present invention the heating of the material occurs in the elongated, smooth extrusion die not in the extruder barrel. In contrast, the non-heated extruder barrel in the present invention is merely a means for conveying the particulate mixture into the extrusion die....

Furthermore, Zavasnik has no heating means within the die cavity of die (26), as contended by the PTO, that acts to heat particulate material mixture to a temperature substantially above the softening temperature of the primary particles. The mere fact that forming die (26) is in 'close proximity' to extrusion die (11) as contended by the PTO would not permit such heating to occur within the forming die (26), particularly in view of the thermal barrier (25) between the two dies.

Culligan argues this position contradicts KXI's current position, because KXI's construction would permit the die to be heated by the barrel by means of the proximity of the barrel and the die. Culligan contends that KXI cannot argue one way to obtain allowance of their claims and another way to establish infringement, citing Spectrum Int'l, Inc. v. Sterilite Corp., No. 98-1243, 1998 WL 854715 at (Fed.Cir. Dec. 9, 1998), and that therefore, the court should reject KXI's construction of the phrase "means ... for heating."

KXI argues that Culligan's prosecution history argument is flawed because it is based on a mistake. KXI alleges the examiner called the structure denoted by reference number 11 in the Zavasnik patent the "barrel" and the patentee called it the "extrusion die." KXI contends the patentee only accidentally adopted the examiner's terminology at several points during the prosecution. KXI alleges, in fact, the patentee distinguished the Zavasnik patent based upon the fact that the Zavasnik patent disclosed two dies, (11) and (26), and a thermal barrier between the two dies to prevent cross-over heating.

The court finds that during the prosecution history, the patentee overcame the examiner's prior art objection that "the extrusion die (26) [of Zavasnik] is clearly heated at its inlet end by its close proximity to the heated extruder barrel (11) ...." by amending claim 1 to recite "means *in said die adjacent to the inlet end thereof*

for heating said particulate mixture...." The patentee offered further explanation, arguing that in the extruder disclosed in the Zavasnik patent, heating the material occurs in the structure denoted as 11, and not in the forming die (26), and that the proximity of the forming die to the structure denoted as 11 would not cause heating to occur in the forming die (26) "particularly in view of the thermal barrier (25) between the two dies." In the present invention, the patentee argued, the "heating of the material" occurs in the extrusion die, and not in the "non-heated extruder barrel." Here, the patentee disclaimed means for heating the particulate material to a temperature substantially above the softening temperature of the binder material that are not "adjacent to the inlet end" of the die. The patentee also distinguished the "8 patent as having a "non-heated extruder barrel."

The Federal Circuit teaches "that one construing means-plus-function language in a claim must look to the specification and interpret that language in light of the corresponding structure, material, or acts described therein, and equivalents thereof, to the extent that the specification provides such disclosure." In re Donaldson Company, Inc., 16 F.3d 1189, 1192 (1994). The court declines to adopt KXI's interpretation that the means are "the walls of the die[,]" because the court finds, this does not adequately describe the means. Instead, the court finds that the "8 patent defines "means in said die adjacent to the inlet end thereof for heating said particulate mixture within said die cavity" as "heating elements 28."

5. ***What is the proper Construction of the Phrase "heating said substantially uniform mixture within said die" in*** the '092 Patent***?***

[14] Claim 1 of the '092 patent contains the phrase: "heating said substantially uniform mixture within said die to a temperature substantially above the softening temperature of said binder material but to a temperature less than the softening temperature of said primary material [.]" KXI contends this phrase means that at least a portion of the mixture is heated above the softening temperature of the binder while the mixture is in the die. Culligan contends this phrase means that the heating must be applied to the mixture while it is in the die. Culligan contends the claim limitation cannot be met by an extruder that heats the mixture solely by applying heat to the extruder barrel.

In support of its construction, Culligan cites several passages from the best mode section of the '092 patent's specification. Culligan cites column 8, lines 58-65 of the '092 patent, which reads in relevant part:

The barrel of the extruder is modified to operate at ambient room temperature or to provide mild preheating ... and the powder is transported through the barrel at a temperature below the softening point of the binder resin. Heat resulting from friction within the barrel can, if desired, be removed by the circulation of coolant through both the screw and barrel.

Culligan cites column 4, lines 44-48 of the '092 patent, which reads in relevant part:

It is important that the feed material 38 entering the die 26 remain flowable. For that reason, the preheating which occurs within the extruder barrel 12 should not closely approach the softening point of the binder material. However, preheating is useful because it reduces the amount of additional heat that must be supplied within the die 26.

Culligan argues these passages define the phrase "heating ... within the die" to require the entire mixture be heated above the softening temperature of the binder in the die, and not in the barrel.

Culligan also argues that plaintiffs are estopped by the prosecution history of the "8 patent from arguing that "heating ... within the die" does not require that all of the mixture be heated to a temperature substantially above the softening point of the binder in the die. KXI responds that it is improper to consider the "8 patent's prosecution history in this context. KXI argues that furthermore it has not treated the phrase "heating ... within said die" in claim 1 of the '092 patent the same as the phrase "means in said die for heating...." KXI also points out that the '092 patent claim containing this phrase is not in means-plus-function language, and is therefore not limited to the specification, as is the related phrase in the "8 patent.

The "8 patent was filed as a continuation-in-part of the co-pending '092 patent. Claim 1 of the "8 patent contains the phrase: "means in said die adjacent to the inlet end thereof for heating said particulate mixture within said die cavity to a temperature substantially above the softening temperature of said binder material but less than the softening temperature of said primary material." Claim 1 of the '092 patent contains the phrase: "heating said substantially uniform mixture within said die to a temperature substantially above the softening temperature of said binder material but to a temperature less than the softening temperature of said primary material [.]" Both of these limitations concern the heating phase of the extrusion process described in the patents.

During the prosecution of the "8 patent, the patentee made statements distinguishing the extruder disclosed by the Zavasnik patent based upon where heating occurs. The patentee argued the "heating of the material" occurs in the extrusion die, and not in the "non-heated extruder barrel." The court finds these statements are relevant to interpreting the meaning of the '092 patent claim limitation at issue.

The court finds the plain meaning of the words of the claim limitation at issue disclose heating the mixture to a temperature above the softening temperature of the binder in the die, and not in the barrel. Furthermore, the court finds the words of the claim and the best mode descriptions relied upon by Culligan are consistent with the statements made during the prosecution of the "8 patent

The court finds that the '092 patent teaches heating the mixture to a temperature above the softening temperature of the binder material in the die, and not in the barrel. In reaching this conclusion, the court relies upon (1) the plain meaning of the words of the claim; (2) passages from the best mode section of the patent specification cited by Culligan; and (3) the "8 patent's prosecution history. Accordingly, the court construes the phrase "heating said substantially uniform mixture within said die to a temperature substantially above the softening temperature of said binder material" in the '092 patent to mean that the substantially uniform mixture is heated to a temperature substantially above the softening temperature of the binder while the mixture is in the die. This claim limitation precludes heating the mixture to a temperature substantially above the softening temperature of the binder material while the mixture is in the barrel, but it does not preclude preheating the mixture in the barrel.

6. *What is the Proper Construction for the Phrase "substantially above the softening temperature of said binder material" in the '092 and* "8 Patents***?***

[15] Claim 1 of the '092 patent includes the phrase "heating said substantially uniform mixture within said die to a temperature substantially above the softening temperature of said binder material...." Claim 1 of the "8 patent includes the phrase "means in said die adjacent to the inlet end thereof for heating said particulate mixture within said die cavity to a temperature substantially above the softening temperature of said binder material...." KXI contends the phrase "substantially above" means the minimum heat required by the claims. This is a temperature which is sufficiently high both to form a composite and to keep the mixture from

solidifying in the extruder. Culligan contends the phrase "substantially above" means that the temperature exceeds the softening temperature of the binder by approximately 25 degrees Celsius.

Culligan relies on statements in the specifications of the '092 and "8 patents that the heat applied to the mixture be "generally about 25 degrees Celsius above" the softening temperature of the binder. *See* U.S.Patent No. 5,189,092, column 2, lines 12-15; '092 patent, column 9, lines 9-10; U.S.Patent No. 5,249,948, column 2, lines 16-19. KXI argues that "generally about 25 degrees Celsius above" the softening temperature of the binder is a preferred example, but does not define the term "substantially above." According to KXI, the specification sections relied on by Culligan are "neither attempts to define the claim terms nor are they expressed as requirements in order to practice the claimed invention." Therefore, KXI argues, the court should not read them as defining the claim.

KXI argues that Culligan's interpretation violates the doctrine of claim differentiation with respect to the '092 patent. Claim 5 of the '092 patent, which is dependent upon claim 1, includes the limitation "at least about 25 degrees Celsius above the softening temperature of said binder material."

KXI also argues that a set temperature increase would fail to account for the variety of different binders that may be used, each of which may have different temperature requirements. According to KXI, the specifications set out an operating window within which the temperature must fall. This operating window necessarily varies based upon the specific binder material used. The parameters are set by column 5, lines 31-36 of the '092 patent, and column 5, lines 37-41 of the "8 patent. These passages read: "There is a minimum heat and a maximum heat-if a substance is heated insufficiently, it will not solidify and will be very prone to 'locking' within the extruder die. If overheated, it will have a strong tendency to lock up within the die." According to KXI, defining the phrase "substantially above" to mean 25 degree Celsius is contrary to the teaching of the invention that the parameter for the heating temperature be set according to the qualities of the binder used.

KXI recognizes that the "minimum heat and ... maximum heat" requirement is "intended to teach that there is a limited range of temperatures that can be used in plaintiff's process." But, KXI argues, this requirement does not provide a definition of "substantially above" as used in both claims.

Claim 5 of the '092 patent is dependent upon claim 1. If the court were to construe "substantially above" to mean the temperature exceeds the softening temperature of the binder by approximately 25 degrees Celsius, claim 5 would be superfluous. *See, e.g.,* Tandon Corp. v. United States Int'l Trade Comm'n, 831 F.2d 1017, 1023 (Fed.Cir.1987) ("To the extent that the absence of such difference in meaning and scope would make a claim superfluous, the doctrine of claim differentiation states the presumption that the difference between claims is significant.") The court notes "[t]here is presumed to be a difference in meaning and scope when different words or phrases are used in separate claims." *Id.*

The specification has stated that "substantially above" is "generally at least about 25 degrees Celsius" and is "preferably at least about 25 degrees Celsius above the softening point of the binder...." The court finds, however, the specification does not define the term "substantially above" to mean "about 25 degrees Celsius." The court finds a lower temperature difference might satisfy the "minimum heat and ... maximum heat" requirement, depending upon the binder used. Accordingly, the court construes the phrase "substantially above" to mean a temperature which is sufficiently high both to form a composite and to keep the mixture from solidifying in the extruder.

7. *What is the Proper Construction for the Phrase "[w]hereby said substantially uniform particulate mixture is deformed, consolidated into a desired form and solidified in the extrusion die and is extruded from said die cavity as a solid composite porous article" in* the "8 Patent***?***

[16] [17] Claim 1 of the "8 patent contains the phrase "[w]hereby said substantially uniform particulate mixture is deformed, consolidated into a desired form and solidified in the extrusion die and is extruded from said die cavity asa solid composite porous article." KXI contends this "whereby" clause merely states the necessary result of operating a device containing the claimed elements. According to KXI, it does not add any additional claim limitations. Culligan contends the "whereby" clause adds a limitation to the claim. Culligan construes the "whereby" clause to mean that, as a necessary result of the above steps, the " 'substantially uniform particulate mixture' changes form due to softening, is shaped under pressure and is solidified, all within the extrusion die, and the resulting product is extruded from the die as a solid composite article having pores."

KXI argues that the Federal Circuit teaches that a "whereby" clause that merely states the result of the limitations in the claim, "adds nothing to the patentability or the substance of the claim[,]" citing Texas Instruments v. ITC, 988 F.2d 1165, 1172 (Fed.Cir.1993). According to KXI, the "whereby" clause of claim 1 "merely states the necessary result of operating a device containing the claimed elements," and therefore, "does not add any additional claim limitations."

Culligan argues that the "whereby" clause was added to the claim to overcome an examiner's objection, and as such it "must be deemed an essential feature necessary to the establishment of infringement[,]" citing Eltech Sys. Corp. v. PPG Indus., Inc., 710 F.Supp. 622, 633 (W.D.La.1988), *aff'd* 903 F.2d 805 (Fed.Cir.1990). *See also* Quality Semiconductor, Inc. v. Pericom Semiconductor, Inc., No. C-95-01785 MHP, 1998 WL 118186, at *5-6 (N.D.Cal. March 2, 1998); Thermalloy Inc. v. Aavid Eng'g, Inc., 935 F.Supp. 55, 60 (D.N.H.1996), *aff'd,* 121 F.3d 691 (Fed.Cir.1997).

According to Culligan, during the prosecution of the "8 patent, the patentee amended claim 1 to include the present "whereby" clause "for the express purpose of distinguishing that claim over the prior art." The patentee made the following amendment: "whereby said [solid composite material] *substantially uniform particulate mixture is deformed, consolidated into a desired form and solidified in the extrusion die and* is extruded from said die cavity as a solid composite *porous* article." The patentee added this language to claim 1 to overcome a rejection based on the prior art of the Leitl and Zavasnik patents.

According to Culligan, the patentee relied on the amended "whereby" clause to distinguish the Leitl and Zavasnik patents. For example, the patentee distinguished the invention of the application from Zavasnik as follows: "solidification [in the Zavasnik extruder] ... takes place outside the extrusion die, i.e., in the water chamber (12), whereas in the claimed invention of this Application, deformation, consolidation and solidification of the particulate matter occurs in the die cavity."

The court agrees with Culligan that the patentee amended claim 1 by adding the "whereby" clause to overcome a rejection by the examiner, and then relied on the amendment to distinguish prior art. The court finds the "whereby" clause does not merely state the result of the limitations of the claim, but adds limitations to the claim. The court construes the "whereby" clause according to the ordinary meaning of its terms. Accordingly, the court finds the phrase, "[w]hereby said substantially uniform particulate mixture is deformed, consolidated into a desired form and solidified in the extrusion die and is extruded from said die cavity as a solid composite porous article [,]" means that, as a necessary result of the above steps, the

"substantially uniform particulate mixture" changes form due to softening, is shaped under pressure, and is solidified, all within the extrusion die, and the resulting product is extruded from the die as a solid composite article having pores.

C. ***Disputed Terms and Phrases in the '311 and '722 Patents***

1. ***What is the Proper Construction for the Phrase "combining ... in a substantially uniform mixture" in*** the '311 Patent***?***

Claims 1 and 94 of the '311 patent contain the phrase: "combining the first and second quantities of particles in a substantially uniform mixture wherein said binder material is present in an amount of at least about 3% by weight of the mixture...." KXI contends the words should be given their ordinary meaning, and that these phrases refer to a largely-but not necessarily wholly-even distribution of particles. KXI contends there are no other mixing requirements and no special methods of mixing are required.

Culligan contends the '311 patent specification defines the terms "substantially uniform mixture" in a special way. According to Culligan, "substantially uniform" is a limitation requiring the formation of stable attachments between the primary particles and binder particles. Culligan argues that the claim requires vigorous mixing until stable "prebonds" or "microaggregates" are formed between the primary particles and binder particles throughout the mixture.

For the same reasons articulated above in section II.B.1 of this opinion, the court construes the phrases "substantially uniform particulate mixture" and "substantially uniform mixture" according to their ordinary meaning. Accordingly, the court finds "substantially uniform mixture" means a largely-but not wholly-even distribution of particles.

2. ***What is the Proper Construction for the Phrase "heating ... in the absence of pressure or shear" in*** the '311 Patent***?***

[18] Claim 1 and claim 94 of the '311 patent include the phrase: "heating said substantially uniform mixture, in the absence of pressure or shear sufficient to convert the binder particles...." KXI contends the phrase "in the absence of pressure or shear sufficient to convert the binder particles" means that any pressure and shear applied to the "substantially uniform mixture" during heating should not be sufficient to convert the binder particles to a continuous web matrix or forced point-bonds. KXI also contends this phrase does not require that all of the mixture be heated prior to the application of sufficient pressure and shear to convert the binder particles. Culligan contends "in the absence of pressure or shear sufficient to convert the binder particles" means subjecting the mixture to "as little pressure and shear as possible during the entire heating process." Culligan contends at a given location along the extruder, the entire mixture must be fully heated before sufficient pressure and shear are applied to the mixture to convert the binder.

According to KXI, some pressure or shear is permitted while the mixture is being heated, so long as there is not enough pressure or shear to convert the mixture into a continuous web matrix or forced point-bonds. KXI cites passages from the '311 patent specification that disclose the presence of some pressure or shear before the "substantially uniform mixture" has been heated to a temperature above the binder's softening temperature. *See* U.S.Patent No. 5,019,311, column 19, lines 35-48; column 19, lines 39-42; column 12, lines 61-66.

Culligan argues that the prosecution history of the '722 patent supports its interpretation. The application

which led to the '722 patent was originally filed as a subsequent, divisional application of the co-pending application which led to the '311 patent, and was prosecuted after the '311 patent issued. The court will not rely on the prosecution history of the '722 patent here in interpreting the claims of the '311 patent.

Culligan cites passages from the '311 patent's specification stating that no pressure should be applied after heating. Culligan cites column 18, line 67 to column 19, line 2. This states "[d]uring heating, no pressure is applied and no effort is made to consolidate the powder. The powder must be at the desired temperature before pressure and shear are applied." The court notes, however, that the statement was made in the context of a discussion of compression molding, one method offered for producing the composite material. Culligan also cites passages from the '311 patent's specification stating that the mixture should be heated "in the absence of any significant pressure or shear." U.S.Patent No. 5,019,311, column 5, lines 3-15; column 12, lines 33-41.

The court agrees with KXI that the '311 patent's specification permits some pressure or shear to occur before the particulate mixture has been heated to a temperature "substantially above the binder's softening temperature." The court construes the contested phrase according to the plain language of the words of the claim. Accordingly, the court construes the phrase "in the absence of pressure or shear sufficient to convert the binder particles" as follows: any pressure and shear applied to the mixture must not be sufficient to convert the mixture to a continuous web matrix or forced point-bonds until the mixture has been heated to a temperature substantially above the softening temperature of the binder.

KXI contends the claims of the '311 patent do not require all the mixture to be heated prior to the application of sufficient pressure and shear to convert the binder. Culligan contends that all of the mixture at a given axial location must be fully heated before pressure and shear are applied to convert the binder. The court finds no reason to read either of these interpretations into the definition of the contested phrase.

3. *What is the Proper Construction for the Phrase "thereafter applying pressure and shear to the heated mixture" in* the '311 Patent***?***

[19] Claim 1 and claim 94 of the '311 patent contain the phrase "thereafter applyingpressure and shear to the heated mixture sufficient immediately to convert at least a portion of the binder material...." KXI contends this phrase means applying sufficient pressure and shear to convert the heated binder into either a continuous web matrix, as disclosed in claims 1 and 94, or forced point-bonds, as disclosed in claim 94. KXI contends no specific amount of pressure or shear is required. KXI argues its construction is supported by the plain meaning of the words in the claims.

Culligan contends this phrase means applying pressure and shear sufficient to convert at least a portion of the binder materials after the entire mixture has been heated to a temperature above the softening temperature of the binder. Culligan contends the pressure required during the conversion step must be (1) greater than the pressure applied during the heating step; and (2) greater than 400 psi to achieve "forced point-bonds" and greater than 4,000 psi to achieve a "continuous web matrix."

Regarding the temporal limitation, Culligan argues that the plain meaning of the claims imposes this requirement. Culligan responds to KXI's arguments by alleging KXI has ignored the "thereafter" limitation in the claim, which imposes a temporal restriction requiring that the pressure and shear sufficient to convert the mixture be applied after the heating step. Culligan argues that its definition of the claim takes into consideration the continuous nature of the extrusion process. According to Culligan, "if ... you take a cross-

section of mixture at any given position along the length of the extruder, the conditions that piece of mixture has to be seeing have to conform to the process steps. In other words, that piece of the mixture has to be first heated. Then it has to be pressurized."

Culligan argues the specification of the '311 patent establishes that the pressure required to achieve "forced point-bonds" is at least 400 psi. The patentee distinguished the Degen '683 patent (U.S.Patent No. 4,664,683) at column 2, lines 43-45 of the specification. This reads in relevant part:

The levels of compression disclosed by Degen et al. are exceedingly low, 0.3-10 psi ... most preferred maximum 40 psi.... Accordingly, it describes process conditions well outside the range of compression utilized in the present invention, which would be 400-1000 psi ... for granular materials ... and approximately 8,000 psi ... or more for powders.... Without such higher pressures, the binder resins are not activated and the novel structure produced by the current invention are not obtained.

Culligan argues KXI is estopped from arguing now that their process covers pressures lower than 400 psi, because KXI disclaimed lower pressures in distinguishing the Degen '683 patent.

Culligan argues the '311 patent's specification establishes that pressure required to achieve a "continuous web matrix" is at least 4,000 psi. Culligan cites passages from examples drawn from the patent's specification stating that successful examples of "continuous web matrix" formation occurred only at pressures in excess of 4,000 psi. Culligan cites passages from the examples section using pressures below 4,000 psi that produced unsuccessful results. Culligan argues that patent claims should be construed consistently with examples given in the patent, citing Johns Hopkins v. CellPro, Inc., 152 F.3d 1342, 1349 (Fed.Cir.1998).

KXI argues in response that "no specific amount of pressure and shear is required by the claims." According to KXI, the '311 patent only requires the application of "sufficient" pressure and shear to convert the heated binder into either a "continuous web matrix" or a "forced point-bonding."

The court agrees with Culligan that the term "thereafter" applies a limitation that "applying pressure and shear to the heatedmixture sufficient immediately to convert at least a portion of the binder material" occurs after the mixture is heated "substantially above" the binder's softening temperature.

The court finds that the specification does not define pressure to mean greater than 400 psi to achieve "forced point-bonds" and greater than 4,000 psi to achieve a "continuous web matrix." The court finds, however, that the patentee disclaimed using pressures below 40 psi in the claimed invention when the patentee distinguished the pressures used in the Degen '683 patent. Accordingly, the court construes the phrase "thereafter applying pressure and shear to the heated mixture sufficient immediately to convert at least a portion of the binder material" to mean applying pressure greater than 40 psi and shear sufficient to convert at least a portion of the binder materials after the entire mixture has been heated to a temperature above the softening temperature of the binder.

4. ***What is the Proper Construction for the Phrase "substantially above the softening temperature" in*** the '311 Patent***?***

[20] Claims 1 and 94 of the '311 patent contain the phrase: "substantially above the softening temperature of said binder material but to a temperature less than the softening temperature of said primary material." KXI

contends the phrase "substantially above ..." means the temperature is sufficiently above the softening temperature of the binder to allow conversion of the binder to a continuous web matrix or forced point-bonds. KXI contends no specific temperature is required. Culligan contends the phrase "substantially above ..." means the temperature exceeds the binder's softening temperature by at least approximately 20 degrees Celsius.

KXI argues that this phrase is similar in meaning to the same phrase used in the '092 and "8 patents. KXI argues that the plain meaning of the words defines the meaning of the claims. According to KXI, no specific temperature is required under the claims, and setting out such a requirement would not even be feasible because the temperature needed to convert the binder varies based upon the size and shape of the object being produced and the binder selected. KXI cites in support column 14, lines 56-59 of the '311 patent. This reads in relevant part: "The [continuous web matrix] ... process is ... usually carried out within a preferred operational range. This range may vary with the size and shape of the object being produced."

Culligan derives its definition of the phrase at issue from the '311 patent's specification at column 12, lines 36-40, in the "Detailed Description of CWM/FPB Process" section. This states as a basic requirement that "[i]n the absence of any significant pressure or shear, the mixture is first brought to a temperature sufficiently above (preferably at least about 20 degrees Celsius, most preferably about 40 degrees Celsius above) the softening point of the binder resin...."

Culligan also argues that the patentee disclaimed processing temperatures used in the Degen '683 patent in distinguishing it. Culligan cites the '311 patent's specification at column 2, line 52 to column 3, line 2. This passage describes the prior art process disclosed in the Degen '683 patent and distinguishes it from the present invention. The passage reads in relevant part:

Degen et al .... describes a process using a temperature of approximately 275 degrees F (135 degrees C), which is generally below the temperatures required in the subject invention to achieve the desired novel structures. Formation of a novel continuous polymer phase or forced point-bonding, according to the present invention, even with the lowest melting point resin available, ethylene-vinyl acetate copolymer (EVA), usually occurs at 145 degrees Celsius ... and is optimal in the range of 165-210 degrees Celsius. *The temperatures required by the process of the subject invention are therefore substantially higher than required for diffusion bonding processes such as that described by Degen et al., even for the binder resin having the lowest melting point*. Degen et al. teach the use of temperatures only sufficient to produce a softening of the binder because they are seeking a point bond and are not seeking a more dramatic conversion of the thermoplastic binder into a different physical form. (Emphasis added).

Culligan contends the manufacturer's specification sheet specifies that the EVA binder used in the Degen '683 process (532 EVA) has a softening temperature of approximately 75 degrees Celsius and a melting point of approximately 96 degrees Celsius. U.S.Patent No. 4,664,683, col. 6, lines 31-34; col. 14, line 66 to col. 15, line 1. The Degen '683 patent uses a processing temperature of 135 degrees Celsius, which is 60 degrees Celsius higher than the softening point of the 532 EVA binder. The '311 patent distinguishes the Degen '683 patent's prior art based upon the temperatures required for the respective processes. The '311 patent characterized the temperatures disclosed by the Degen '683 patent as "generally below" the temperatures needed to produce the "continuous web matrix" and "forced point-bonding" structures disclosed in the '311 patent.

Culligan also cites examples 17 and 18 from the '311 patent's specification. These examples disclose that

pellets produced by compression molding mixtures of stainless steel powder, 532 EVA binder and powdered ion exchange resin crumbled when heated to temperatures at and below 170 degrees Celsius, which is 95 degrees Celsius above the 532 EVA's softening temperature. Culligan also cites a passage from the '311 patent's specification characterizing temperatures necessary to process activated carbon and 532 EVA as 190 to 210 degrees Celsius, or 125 to 155 degrees Celsius above the 532 EVA binder's softening temperature. KXI argues in response that the Degen '683 patent talks about process temperature, and not the mixture temperature, and that example 17 of the '311 patent talks about the mold's temperature.

The court agrees with KXI that the temperature needed to convert the binder varies based upon the size and shape of the object being produced and the binder selected. Accordingly, the court construes the phrase "substantially above the softening temperature" to mean sufficiently above the softening temperature of the binder to allow conversion of the binder to a continuous web matrix or forced point-bonds.

5. *What is the Proper Construction for the Phrase "continuous webbing structure" in* the '311 Patent*?*

[21] Claims 1 and 94 of the '311 patent contain the phrase "substantially continuous webbing structure." KXI contends this phrase means a thin, substantially continuous film or web which has the purpose to create a self-supporting structure for the primary materials. KXI further contends the web is continuous but not solid, and it may have a large volume of voids or pores filled with air or gases.

Culligan contends this phrase is indefinite, as the specification offers no meaningful definition of the phrase. If the phrase is not indefinite, then Culligan contends an additional element must be added to the definition of the claim: that material compositions characterized as such are readily converted into fibers by the application of stress. In support of this element, Culligan cites the '311 patent's specification at column 5, lines 33-41 which reads:

[a]n additional feature of the products formed by this process is that they can be 'fiberized.' The web matrix portion of the resulting structure, when formed from most common crystalline polymers can be converted to a matrix of fibers holding the primary particles in 'pockets.' This can be achieved through the application of even a mild shear.

Culligan also cites column 7, lines 27-36, which reads:

[continuous web matrix] materials have the unique characteristic that the binder within these structures, when a crystalline polymer, can be converted to a dense matrix of fibers by the application of stress to the structure. Such stress can be the result of pulling, cutting, or compressing the [continuous web matrix] structure.

According to Culligan, this is the only means offered by the patent specification "for anyone to determine whether or not they have a [continuous web matrix] structure as opposed to something else...."

According to KXI, it "does not dispute that the examination of fibers after the application of shear is one test that can be performed to determine if an article includes a continuous web matrix." KXI argues, though, this is not the only test, and alleges this test is particularly difficult to perform on end products using carbon primary particles ("testing for the formation of fibers is extremely subtle because the testing itself can destroy the structure."). Also, KXI argues, this test may not be accurate because only a portion of the binder need be converted to meet the claim limitations.

The court will not address Culligan's indefiniteness argument at this time, as this goes to the validity of the claim, and not how it should be construed. The court agrees in part with Culligan. The court finds that the specification defines "continuous webbing structure" as material compositions that can be converted into fibers. The court, however, finds that the term "readily" proposed by Culligan in its definition is an extraneous limitation. Accordingly, the court construes "continuous webbing structure" to mean a thin, substantially continuous film or 'web' which may have a large volume of pores or voids, and which has the purpose to create a self-supporting structure for the primary materials, and which is convertable into fibers.

6. *What is the Proper Construction for the Phrase "forced point-bonds" in the '311 and the '722 Patents?*

[22] Claim 94 of the '311 patent and claim 77 of the '722 patent contain the phrase "forced point-bonds." KXI contends this phrase means that two or more primary particles are joined together by an adhesive. Culligan contends this term is indefinite, as the specification offers no meaningful description of the term. If the court determines the term is sufficiently definite, Culligan accepts KXI's definition. The court will not address Culligan's indefiniteness argument at this time, as this goes to the validity of the claim, and not to its meaning. Accordingly, the court finds "forced point-bonds" means two or more primary particles joined together by an adhesive.

7. *What is the Proper Construction for the Phrase "rapidly cooling" in* the '311 Patent***?***

[23] Claim 1 and claim 94 of the '311 patent contain the phrase "substantially immediately after formation of said continuous binder structure, rapidly cooling said mixture to below the softening point of the binder material to retain said converter binder material in its continuous webbing structure condition to produce the composite material." KXI contends "rapidly cooling" requires cooling the mixture to below the softening temperature of the binder material in a sufficiently short enough time to prevent wetting of the carbon by the binder and deterioration of the bonds. Culligan contends "rapidly cooling" means cooling as rapidly as practicable to retain the composite material's structure. Culligan contends "rapidly cooling" includes cooling by ordinary methods to a temperature below the softening temperature of the binder, including by allowing the part to cool naturally in ambient air.

The term "wetting" never appears in the '311 patent. KXI contends wetting means the softened binder particles penetrate the primary particles or completely surround the primary particles. KXI alleges that wetting of carbon particles by softened binder particles can cause the bonds between carbon and a binder to break down, causing deterioration of the bonds.

KXI argues the inventors recognized that wetting is a problem, and that it may be solved by rapid cooling. KXI relies on column 14, lines 8-16 of the '311 patent's specification, which reads in relevant part:

It has been shown that, if the product of the [continuous web matrix] or [forced point-bonding] processes is held for an extended period at the elevated temperature, there is a rapid deterioration of the product and loss of the continuous web or binding points. Therefore, following the formation of continuous binder resin structure in the [continuous web matrix] product or bonding points in the [forced point-bonding] product, the material should be cooled rapidly, preferably as rapidly as possible.

KXI contends the inventors developed "rapid cooling" to solve the wetting problem. KXI argues, "rapidly cooling" requires cooling the mixture to below the binder's softening temperature in a sufficiently short

enough time to prevent wetting of carbon by binder. KXI therefore construes "rapidly" to mean sufficiently quickly to prevent wetting or deterioration of the bonds.

Culligan argues its interpretation is supported by the '311 patent's specification. Culligan cites column 13, lines 4-8. This reads in relevant part: "the resulting immobilized material is relatively quickly cooled to a temperature below the melting point of the binder to 'freeze' the unstable structure once it is formed." Culligan cites column 14, lines 22-23. This states that "[w]ater sprays or air blasts may be used to hasten cooling." Culligan also cites example 1, at column 26, lines 34-35, which discloses utilizing air cooling to cool pellets that were made in a 0.5 inch diameter cylindrical compression molding die.

KXI responds that Culligan's construction of the phrase containing "rapidly cooling" would allow air cooling in any situation. According to KXI, air cooling may not be appropriate in certain circumstances to "rapidly cool" the product. KXI argues that:

"[b]ecause the type of cooling depends on many factors, including the temperature and size of the article and the thermal mass of the mold surrounding the article, it would be improper to define 'rapidly cooling' as allowing any type of cooling.... Instead ... the cooling must be sufficiently fast to prevent wetting of the carbon and deterioration of the bonds."

The court finds that preventing "wetting" never appears in the '311 patent, and is not required by the claim. Otherwise, the court agrees with KXI's interpretation. The court construes "rapidly cooling" to mean cooling the mixture to below the softening temperature of the binder material in a sufficiently short enough time to prevent deterioration of the bonds.

8. *Are the '722 Patent Claims Product-By-Process Claims?*

[24] KXI argues that the '722 patent's claims at issue are pure product claims, and do not incorporate any process limitations. Culligan contends the '722 patent claims at issue are product-by-process claims, which inherently incorporate the process steps disclosed in the '722 patent.

KXI acknowledges that claim 87 of the '722 patent is a product-by-process claim because it is defined in terms of the process by which it is made, as it contains the phrase "said composite material produced according to a process comprising:" and then goes on to describe the process. KXI argues, however, that Culligan is wrong as a matter of law with respect to the other '722 patent claims, citing Mentor Corp. v. Coloplast, Inc., 998 F.2d 992, 997 (Fed.Cir.1993) ("Product-by-process claims are claims which describe the product more by the process used to obtain it than by its structure."). KXI argues that the '722 patent's claims at issue are unlike claim 87, as they do not contain any limitations as to how they are manufactured. Therefore, KXI argues, they are product claims.

Culligan argues the '722 patent claims at issue must be construed to include some limitations to render them meaningful to a person skilled in the art. According to Culligan, the claims at issue in the '722 patent define the claimed products in terms of specific process steps described in the '722 patent. According to Culligan, if the structures disclosed in the '722 patent are divorced from the process steps described in the specification, the '722 patent claims are meaningless.

Culligan argues that the language of the claims supports its argument. Claim 1 of the '722 patent requires the binder particles be "formed" into a "substantially continuous thermoplastic binder phase supporting and

enmeshing [the] primary particles." According to Culligan, the language of the claim requires the primary particles be "consolidated" into a "uniform matrix with the continuous binder material present as a dilute material within the pores between the primary particles." According to Culligan, the language of the claim recites that the continuous binder phase be "forced" into "macropores and exterior voids" of the primary particles. Claim 77 of the '722 patent requires a "uniform matrix" be "formed" from binder particles, and that the primary particles be "consolidated" in the uniform matrix "with melted and resolidified binder matrix present as forced point-bonds between the primary particles." According to Culligan, the language of the claim requires the binder material be "forced into macropores and exterior voids of individual primary particles" to "form physical connections" between particles.

Culligan argues the prosecution history supports a product-by-process limitation. On May 3, 1991, the PTO rejected claims 1 and 77 of the '722 patent as an obvious "concept of a plurality of primary particles and a matrix binder, the particles having a higher softening temperature than the binder." On August 29, 1991, the patentee responded hat the examiner's characterization was "a gross over-simplification of the novel products produced by applicant's process." The patentee argued that new characteristics "are the result of following applicant's process of applying a specified pressure to the heated mixture followed by rapid cooling." On January 10, 1992, the PTO issued a final rejection of the application's claims as obvious. The patentee argued the "invention employs a novel process ... to produce novel porous composite articles which are characterized by three-phase structures, primary particles, binder and gas." The patentee stated "[s]uch novel products result when produced by Applicant's novel process...."

In response, KXI argues that "the full responses to the [o]ffice [a]ctions clearly demonstrate that the claims of the '722 patent were distinguished over the prior art based on differences in structure, not differences in the process by which the articles are manufactured." According to KXI, the examiner recognized there were differences between the product claims in the '722 patent and the process claims in the '311 patent. In the first office action, the examiner issued a restriction requirement indicating he felt the method claims (which became part of the '311 patent) were distinct from the composite material claims (which eventually issued as part of the '722 patent) because the product claims could be made using a different process than the one claimed in the '311 patent. Thus, KXI argues, "the [e]xaminer recognized that the product claims of the '722 patent were not limited to any particular method of manufacture."

The court finds the patentee relied on the novelty of the invention's process to distinguish his invention from prior art. In particular, in the March 2, 1992 Amendment and Request for Reconsideration, the patentee distinguished the Stastny and Stayner patents in terms of how the products disclosed in these patents are formed. Accordingly, the court finds the '722 patent's claims are product-by-process claims.

9. *What is the Proper Construction for the Phrase "substantially incapable of fibrillation under normal conditions" in the '722 Patent?*

[25] Claim 1 of the '722 patent contains the phrase "said binder particles being substantially incapable of fibrillation under normal conditions into microfibers of less than 10 micrometers diameter at room temperature...." KXI contends this phrase means that prior to any type of processing, the binder particles are substantially incapable of forming fibers of less than 10 micrometers diameter by shear and pulling alone without heating or substantial compression. Culligan contends this phrase means that the binder particles are substantially incapable of forming fibers of less than 10 micrometers when mechanically worked at room temperature. According to KXI, "[t]he only real area of dispute between the parties is the requirement that the test for fibrillation occur prior to any processing of the binder, i.e., prior to any heating or substantial

compression."

KXI argues that the '722 patent's specification only mentions fibrillation of binder particles when it discusses prior art processes utilizing a polytetrafluoroethylene ("PTFE") binder. This is at column 3, lines 53-55, which reads: "PTFE is unique in that it fibrillates without heating or applying substantial compression but by shear and mixing." KXI contends this sentence from the specification defines the phrase "normal condition" to mean applying shear and pulling alone without heating or substantial compression prior to processing.

In support of its "mechanically worked" definition, Culligan cites column 3, lines 58-61 of the '722 patent specification. This section reads: "[t]he foregoing process using PTFE is complex and time consuming and involves the evolution of fine fibers by mechanically working and shearing a mixture of PTFE and particles."

According to Culligan, the '722 patent's specification is silent as to the meaning of the phrase "substantially incapable of fibrillation." Culligan asserts that the prosecution history of the Australian counterpart to the '722 patent states that this language "was employed to exclude PTFE." The patentee apparently argued in prosecuting the Australian patent, "[t]his is because the PTFE fibrillates by shear and pulling alone at room temperature, i.e., without the necessity for heating or applying substantial compression."

Culligan argues KXI's definition is incorrect because KXI appears to contend that no compression at all may be applied during the test to determine fibrillation, as opposed to no "substantial compression." Also, Culligan objects to the phrase "prior to processing" if it means something other than "prior to processing the binder in accordance with the method disclosed in the '722 patents...."

KXI argues the court need not decide which party is correct because, as a matter of law, this claim limitation must include the crystalline thermoplastic polymers, including polyolefin, listed in claim 33 of the '722 patent. Claim 33 depends from claim 1. It reads: "[t]he composition of claim 1 wherein the binder material forming the matrix is a crystalline thermoplastic polymer selected from the group consisting of ... polyolefins...." KXI argues that, as a matter of law, the independent claim must be interpreted broadly enough to include the dependent claim, citing Wright Medical Tech., Inc. v. Osteonics Corp., 122 F.3d 1440, 1445 (Fed.Cir.1997) ("[W]e must not interpret an independent claim in a way that is inconsistent with a claim which depends from it."). KXI contendsthat, as a matter of claim interpretation, polyolefin is "substantially incapable of fibrillation under normal conditions into microfibers of less than 10 micrometers diameter at room temperature" as that phrase is used in claim 1 of the '722 patent.

Culligan argues that KXI has inverted the law of claim interpretation concerning dependent claims. Instead of reading the dependent claim (claim 33) as a further limitation on the independent claim (claim 1), KXI reads the independent claim as a limitation on the dependent claim. Instead, KXI argues dependent claim 33 must meet the conditions of independent claim 1.

Without further evidence, the court declines to construe claim 33 to mean that polyolefin is "substantially incapable of fibrillation under normal conditions into microfibers of less than 10 micrometers diameter at room temperature" as that phrase is used in claim 1 of the '722 patent. The court declines to add a "prior to processing" requirement to claim 1, as the court finds this is not supported by the evidence. Otherwise, the court agrees with KXI that the phrase "said binder particles being substantially incapable of fibrillation under normal conditions into microfibers of less than 10 micrometers diameter at room temperature ...." means that the binder particles are substantially incapable of forming fibers of less than 10 micrometers

diameter by shear and pulling alone without heating or substantial compression.

10. *What is the Proper Construction for the Phrase "substantially continuous thermoplastic binder phase" in the '722 Patent?*

Claims 1 and 77 of the '722 patent contain the phrase "substantially continuous thermoplastic binder phase." The parties agree that this phrase has the same definition as "continuous webbing structure" in the '311 patent.