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(54) **Method and apparatus for producing foam.**

(57) A method and apparatus for producing foam using a static foam generator containing no moving parts at a rate adequate for commercial needs and possessing properties for ready and rapid application to and absorption by a substrate such as a textile fiber or fabric. The generator comprises a chamber with an inlet at one end and an outlet at an opposite end wherein from about 10 to 100 percent of the total volume of the chamber contains a packing of random fibers or strands.

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"METHOD AND APPARATUS FOR PRODUCING FOAM"

The present invention relates to a method and apparatus for producing foam, particularly for the treatment of textile materials.

The treatment of textile materials with various chemicals, dyestuffs, resins and the like has been long conducted by the use of aqueous baths. In such processes the fabric is essentially saturated by immersion in a water bath containing the treating chemical and eventually the water must be removed in order to continue the processing or to dry the fabric. Of the many procedures employed in the past for the treatment of fabrics, the most commonly employed is the pad-dry process in which the fabric is immersed and saturated with the aqueous treating solution, squeezed between rollers to a given wet pick-up and subsequently dried or dried and cured on a frame or heated drying roll before being taken up in a roll once again. The amount of water retained by the fabric is normally controlled by the pressure of the squeeze roll; in conventional methods a lower limit of about 50 to 70 per cent water based on the weight of the fabric is still retained, depending upon the particular fabric used. This large amount of water requires a tremendous amount of energy in the form of heat to dry the fabric. It has been estimated that the amount of

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energy required to remove the water and dry the fabric is many times greater than the amount of energy that is needed in heating the cloth to carry out the desired chemical treating step, such as for example, in the application and cure of a wash and wear finish on the fabric, or in the continuous dyeing of a fabric. In addition to the pad-dry process, in which the water is removed by squeezing between rollers, other procedures have recently been developed for more efficient removal of water. In one such procedure the saturated fabric is conveyed to a jet squeezer which employs a stream of compressed air jetting outward at the point of contact between the fabric and the nip rolls substantially to reduce the moisture content of the fabric. The use of this technique has resulted in a decrease of the water content in the fabric to about half of that normally remaining when using the squeeze roll technique discussed above. In another procedure vacuum extractor rolls are used. This process entails conveying the wet fabric as it exists from the treating bath over a perforated roll within which a vacuum is created whereby the moisture is extracted from the fabric. In some instances, roller coating methods can be used which continuously deliver aqueous treating composition to the fabric and the add-on is governed by the fabric speed and the rate of delivery of the treating composition by the coating roller. In this procedure the treating composition generally remains predominantly on or near the surface of the fabric, particularly when low add-ons are involved.

Within the past few years, several new approaches have been made to obtain uniform application of

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compositions to porous substrates. These recently developed procedures use foams in different form. However, the methods by which the foams had been applied to treat the fabric or yarn leave much to be desired. One such disclosure is to be found in United States Patent No. 3,697,314 issued October 10, 1972. In this patent there is shown a method for producing foam and then passing a yarn through the foam so as to coat the exterior surface of the yarn with the foamed treating agent. It stresses that the yarn must pass through the foam agglomerate in order to ensure a uniform distribution of the agent over the entire circumferential surface of the yarn as it passes through the foam. The reference shows no means by which the foam could be applied on only one surface of a fabric or material and still obtain uniform distribution or uniform penetration of the interior of the yarn or fabric. An earlier attempt to use foam for the treatment of textile materials is to be found in United States Patent No. 1,948,568, issued February 27, 1934. In this disclosure, a textile material is suspended in a closed container and foam is pumped into the container and forced through the textile material until the textile material is uniformally impregnated from all sides throughout the substrate structure and saturated with the textile treating agent in the form of a foam. In the batch process disclosed in this patent, the textile material is in a stationary or fixed position.

Also of interest in the procedures for producing foam is United States Patent No. 3,865,078 (British Patent Specification No. 1,391,403) which discloses the use of diffusion filters for the production of foams.

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The apparatus and methods disclosed in this reference do not resemble that which are the subject matter of this invention.

More recently new technology has been patented relating to highly improved apparatus and foams. This technology is disclosed in United States Patent No. 4,023,526 issued May 17, 1977 and United States Patent No. 4,099,913 issued July, 1978. This latter technology permits the production and application of foams to textiles at commercially acceptable rates and when properly used it leaves the treated material essentially dry to its touch. However, even with this latest improvement generally all of the prior art has required the use of expensive foam generating equipment that contains many moving parts and requires careful maintenance.

This invention is directed to a foam generator that contains no moving parts and to the methods for producing foams in such static foamers. The static foamer comprises a chamber packed with fibers or strands through which a treating composition and gas are passed to produce a foam. The packed chamber contains no moving parts. The treating composition is introduced into the chamber as a solution, dispersion or emulsion in predetermined amount and simultaneously a gas, such as air, is also introduced in predetermined amount. The two meet and pass through the packing and exit the chamber in the form of a foam. Proper control of the feeds and the configuration of the packing material in the chamber of the static foamer permit the production of foam of a specified density and desired bubble size and froth stability half life. The foams

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are then applied by continuously conveying the foam treating composition to the substrate by suitable application means, for example, as described in United States Patents Nos. 4,023,526 and 4,099,913. That commercially acceptable semi-stable foams could be produced in a static foamer was a completely unexpected, unobvious and surprising discovery.

In the present invention a static foamer is described and claimed that can be used with known foam application means. The foamer of this invention comprises a chamber having at least one inlet means for the introduction of treating composition and gas into the chamber and at least one exit means providing an outlet for the foam produced in the chamber. The chamber can be of any geometrical configuration; it can be tubular, elliptical, spherical, rectangular or square, or any combination thereof, or with any other geometrical configuration. The overall internal volume will vary, as will be obvious to one skilled in the art in light of the teaching herein, on the ultimate use and amount of foam that the user wishes to generate and use.

In its simplest form the static foam generator is a single tubular chamber, having a restricted inlet at one end and a restricted outlet at the other end. The dimensions will vary from a diameter of about 0.25 cm or less to about 30 cm or more and an overall length of about 5 cm or less to 1,000 cm or more. Generally the length varies in direct proportion to the diameter. The proper size to employ in a particular instance will, of course, depend upon the needs of the user and the size of the foam applicator; good engineering design by a competent engineer using acceptable engineering design

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practices will enable one to build a unit of the needed size, whether it is in this tubular form or another of the forms hereafter discussed. The materials of construction used will depend upon the chemical composition that will be foamed. The tubular chamber is filled or packed with inert material in the form of randomly located fibers, strands, or other shaped particles, which will fill from about 10 per cent up to 100 per cent of the chamber. Due to the random structures of this material, however, the chamber contains a significant volume of free space, which can be up to about 90% of its total volume, as will become apparent later. Retainers may be used to confine the packing when the chamber is not completely filled therewith.

One such tubular static foam generator was constructed using a stainless steel tube 1.6 meters long by 3.8 cm in diameter capped at both ends with caps having a 1.25 cm opening. The first 40 cm section at the inlet end was tightly packed with five stainless steel scouring pads made of curled steel strands about 0.075 mm thick and about 0.65 mm wide; each weighing about 60 grams and measuring about 5 cm thick and 11 cm in diameter (as in United States Patent No. 2,196,076). To the inlet there was attached a four-way branched nipple; to the three remaining openings of this manifold connection there were connected a pressure gauge and air feed and liquid feed lines from respective rotameters and feed sources. The outlet end was connected to the foam applicator.

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In a modified version of a tubular generator a section of stainless steel tubing 2.54 cm in diameter and 28 cm long containing two such scouring pads was attached to a section of stainless steel tubing 3.8 cm in diameter and 40 cm long that was packed with five such scouring pads. In this instance the treating composition and air were initially introduced into the narrower section and from thence into the wider section of the static foamer and the foam produced exited via the outlet at the other end of the assembly.

A still further modification of the tubular-type foam generator employed three sections. The initial inlet section consisted of a stainless steel tubing about 1.27 cm in diameter and 10.2 cm in length packed with 0.5 such stainless steel scouring pads, this was connected to a center section 2.54 cm in diameter about 30 cm long packed with two such pads; and this in turn was connected to a final section about 3.8 cm in diameter and 42.5 cm long packed with five such pads. The treating composition and air were introduced through the manifold connection attached to the inlet of the first section and the foam produced exited through the outlet of the final section, which in turn was attached to the foam applicator apparatus.

Such tubular forms of the static foam generator, as can be seen from the above description, can consist of one or more sections of varying lengths and diameters. Such sections need not be of increasing size as in the illustrations discussed above but can be randomly sized and situated. Also, as previously indicated, they need not be of tubular shape but can be, individually or in the combined structure, of different geometric shape.

In one further embodiment of this invention the static foam generator can be integrally united with or be the foam applicator head described in United States Patent No. 4,023,526. In this instance, referring to the figures of said patent, a section of tubular generator is attached to the foam inlet point and this section is packed with such pads; also packed with such pads is the foam distribution chamber. The treating composition and air are introduced through the manifold connection attached to the inlet and of the tubular generator section and then proceed into the packed foam distribution chamber of the foam applicator head. The foam produced then passes through the foam distribution holes of the foam distribution plate or opening into the foam application chamber. The teaching of United States Patent No. 4,023,526 is specifically incorporated herein by reference; as is the teaching of United States Patent No. 4,099,913.

The static foam generators of this invention have many advantages over the foam generators heretofore available. Many of the conventional foam generators cost in the tens of thousands of dollars; the foam generator of this invention can cost as little as fifty dollars or less. All of the prior available foamers require electrical motors, packing of glands etc. for proper operation; our generator requires no motor for its operation thus saving on energy consumption and it has no packing glands or moving parts to wear out and require replacement; the only motors required are those to move the air and treating composition through the system and these are also required with all prior foam generators. The existing equipment is usually quite bulky and requires a relatively large floor area for its installation; our

system requires only enough area to install the tubular chamber in a vertical position and this could be not much greater than the diameter of the tubular reactor. Further, due to the simplicity of construction and operation no special skills are required and since it is a static generator without moving parts there is no need for the coolants required by high speed mechanized foamers. Nor is there any danger of contaminating the treating compositions with extraneous lubricants since there are no moving parts requiring lubrication in our static foamer. Clean-up of the foamer is also simple and in an extreme situation, due to the negligible cost of the packing material, one can simply replace the packing material.

The static foamer of this invention can convert a treating composition to a semi-stable foam that can be used in any of the applications for which foams are used. It can be used to produce the froth compositions described and claimed in United States Patent No. 4,099,913. The chamber of the static foamer is packed, as previously indicated; the packing material can be metallic or synthetic fibers or strands, randomly arranged. Particularly useful as the well known stainless steel pot scouring pads manufactured worldwide by many producers. Also, in some instances pads made of glass, copper or polyamides can be used, if the treating compositions are not affected thereby.

In producing the foam, the ratio of air to liquid treating composition can vary widely. The ratio employed is the primary determinant of the foam density. The foam

density can range from 0.005 to 0.3 g/cc, preferably from 0.01 to 0.2 g/cc.

The foams generally have an average bubble size of from about 0.05 to 0.5 millimeters in diameter and preferably from 0.08 to 0.45 millimeters in diameter. The foam half-life is from one to sixty minutes, preferably from three to forty minutes.

The foam density and foam half-life are determined by placing a specified volume of the foam in a laboratory graduated cylinder of known weight, a 100 cc or 1,000 cc cylinder can be used, determining the weight of the foam in the cylinder, and calculating the density from the known volume and weight of the foam in the cylinder.

From the measured foam density and volume, and the known density of the precursor liquor, the liquor volume which would equal one-half of the total weight of the foam in the cylinder is calculated. The foam half-life is the time for this volume to collect in the bottom of the cylinder.

The foam bubble size is measured on a sample of foam taken at the applicator nozzle and is determined by coating the underside of a microscope glass slide with the foam, placing the slide on the microscope, supporting the slide on each side by two slides, and photographing it at once, preferably within 10 seconds, with a Polaroid® camera at a magnification of 32 fold. In an area of the photomicrograph measuring 73 by 95 mm, corresponding to an actual slide area of 6.77 square millimeters, the number of bubbles is counted. The

average bubble diameter size in mm is then determined by the equation:

$$\text{Average Bubble Size} = \frac{2}{\sqrt{\pi}} \left[\frac{(6.77)\ (\text{Liquid Density-Foam Density})}{\text{No. of Bubbles}}\right]^{1/2}$$

The inlet pressure to the static foamer will range from about 25 psig or less to 250 psig or more. Within this range special pressure equipment would not be required. However, any significant increase above this higher value would require the use of special equipment. The preferred range is from about 50 psig to about 75 psig.

In a typical embodiment, a treating composition is prepared in a suitable vessel. Measured amounts of the treating composition and air, or any other desired gas (nitrogen, argon, carbon dioxide, etc.), are premixed and the mixture is then introduce d into the chamber of the static foamer via the inlet. As the mixture passes through the foamer it is converted to the foam and the foam then exits the static foamer via its outlet and from there it proceeds to the foam applicator apparatus, such as that described in United States Patents Nos. 4,023,526 and 4,099,913, where it is applied to the substrate.

Of course, the static foamer of this invention can also be used in conjunction with any of the present foamers.

The following Examples serve further to illustrate the invention.

Example 1

(A) The Formulation

A formulation was produced in a stainless steel reactor by mixing the following components:

71.25 pounds of 1,3-dimethyl-4,5-dihydroxy-2-imidazolidone, 45% aqueous solution (Permafresh 183 ^{R})

15.75 pounds of zinc nitrate

0.525 pound of the adduct of mixed C_{11}-C_{15} linear secondary alcohols with 7 moles of ethylene oxide (Wetting Agent I)

0.525 pound of the adduct of mixed C_{11}-C_{15} linear secondary alcohols with 12 moles of ethylene oxide (Foaming Agent I)

(B) The Static Foam Generator

A stainless steel tubular static foam generator was assembled, measuring 3.8 cm in diameter and 1.6 meters long. The exit end of the generator was capped leaving a foam outlet 1.25 cm in diameter. A four-way manifold nipple, 1.25 cm diameter, was attached to the cap at the opposite inlet end of the generator. To the remaining three inlets of the manifold there were attached a pressure gauge, an air inlet source with its attached rotameter and a feed line for its liquid formulation with its rotameter.

The first 40 cm section of the generator at the inlet end was packed with five stainless steel scouring pads made of curled steel strands about 0.075 mm thick and 0.65 mm wide. Each pad weighed about 60 grams and measured about 5 cm thick and 11 cm in diameter. The pads were tightly packed into the generator using a tamping rod.

Air and the above liquid formulation were fed into the manifold and through the packed static foam generator. At a liquid feed rate of 309 cc per minute and an air feed rate of about 6,200 cc per minute the reading on the pressure gauge was 30 psig. The flow of foam from the opposite outlet end of the generator was intermittent. The packing was tamped tighter in the generator and the feeds repeated. With the tighter packing a continuous flow of good quality foam having a density of about 0.049 g/cc was produced.

The results illustrate the effect of packing density and inlet pressure and feed rates on foam quality.

Example 2

The static foam generator assembled in this example consisted of two tubular sections. The first inlet tubular section was 2.54 cm in diameter and 28 cm in length. It was packed with two of the pads described in Example 1. This first section was attached to a second tubular section 3.8 cm in diameter and 40 cm in length that was packed with five such pads; the first three were packed tightly and the remaining two quite loosely. The foam outlet was at the opposite end of the second section. The inlet end of the first section was equipped with a four-way manifold nipple connected as described in Example 1.

Using the formulation described in Example 1, the liquid formulation was fed in at a rate of 309 cc/min. and air at a rate of about 6,200 cc/min.; its inlet pressure was 30 psig. The foam produced contained some large bubbles. When the flow of liquid formulation was increased to 400 cc/min. and the air flow maintained at

6,200 cc/min., excellent, uniform foam was produced having a density of 0.064 g/cc. The inlet pressure now was about 55 psig. Excellent, uniform foam was also produced when the packing in the first tubular section of the generator was made tighter by tamping, even while maintaining a liquid formulation feed rate of 300 cc/min. and an air feed rate of 6,200 cc/min.; the tighter packing resulted in an increase in inlet pressure. The results indicated that an inlet pressure to the packed static foam generator of from 55 to 60 psig was required in order to produce good, uniform foam. The foams made under these conditions had densities as low as 0.02 g/cc at inlet pressures of 55 to 60 psig.

Example 3

The static foam generator assembled in this example consisted of three stainless steel tubular sections. The initial inlet tubular section was of stainless steel about 1.27 cm in diameter and 10.2 cm in length packed with one-half of the pads described in Example 1. This initial section was connected to one end of a center section 2.54 cm in diameter and about 30 cm in length that was packed with two such pads. The opposite end of the center section was connected to one end of a final section measuring 3.8 cm in diameter and 2.5 cm in length, this was packed with five such pads. The foam outlet was located at the opposite end of the final section. The inlet end of the initial section was equipped with the four-way manifold nipple, connected as described in Example 1.

Using the liquid formulation described in Example 1 excellent, uniform foams were produced at liquid feed rates of from 50 to 250 cm/min. at air feed rates to maintain an inlet pressure of from about 55 to 60 psig. Under these conditions the foams had densities of from 0.02 to 0.2 g/cc.

Example 4

(A) In this example the static foam generator described in Example 3 was attached to a foam applicator head of the type described in Example 1 of United States Patent No. 4,023,526. The foam applicator head consisted of a lower foam distribution chamber with a foam applicator chamber and nozzle mounted thereto above a foam disbribution plate. The internal dimensions of the lower foam distribution chamber were a length of 16 inches, a width of 2.25 inches and a height of 6 inches from the foam inlet point. This lower foam distribution chamber tapered along its length. The base of this lower foam distribution chamber had a 1.5 inch diameter foam inlet, centrally located. Connected to the foam inlet point there was the stainless steel static foam generator of Example 3 having 12% of its total volume occupied by the strands of the pads described in Example 1. At the inlet end of the static foam generator there was connected the four-way manifold nipple and the air and liquid feed lines and gauge as described in Example 1. Above the foam distribution chamber was a foam distribution plate having a 1/8 inch slot across its length. Above the distribution plate was the foam applicator chamber which extended the full 16 inch length of the foam applicator head, had a height of 4 inches above the foam distribution plate and a nozzle slit width of

0.5 inches between the two nozzle lips thereof. The space between the lips is the foam application chamber. The upstream nozzle was 0.5 inch wide and had an outward taper of 30°. The downstream nozzle lip was 1.25 inches wide with the exterior wall 0.5 inch wide and tapering outward of an angle of 45° and an interior orifice adjuster 0.75 inch wide tapering inward towards the orifice of an angle of 5°. In operation the foam was produced in the packed static foam generator section and passed into the foam distribution chamber. The foam then passed through the slot of the foam distribution plate into the foam application chamber and was applied to the fabric at the orifice of the applicator nozzle. The fabric was drawn across the nozzle lips of the foam applicator head initially contacting the upstream lips and then contacting the downstream lip at the speed indicated below. As the fabric moved across the nozzle orifice and the nozzle lips the foam was applied to the surface of the fabric at a slight positive pressure.

The formulation described in Example 1 was foamed in the equipment described above using a liquid feed rate of 254 cc/min. and an air feed rate of 4300 cc/min.; good, uniform foam was produced having a density of 0.059 g/cc; the inlet pressure was 56 psig. The foam was uniformly applied to a 40 cm wide 50/50 polyester/cotton fabric which weighed 3.7 ounces/square yard that was travelling over the nozzle of the foam applicator head at a speed of 120 feet per minute. The foam was uniformly absorbed by the fabric and an excellent application was achieved.

(B) A dye formulation was produced containing the following components in parts by weight:

2 pts. blue dye (Latyl Blue GFE)

0.75 pt. of a poly(ethylene oxide)

0.75 pt. of sodium sulfate

1 pt. of the sodium salt of naphthalene sulfonic acid

95.5 pts. water

3 pts. acetic acid

This dye formulation was foamed and applied to a fabric using the same equipment and apparatus described in Part A above. The liquid feed rate to the static foam generator was 466 cc/min., the air feed rate was 9,320 cc/min. and the pressure was 56 psig. The foam produced had a density of 0.05 g/cc. The application to the fabric was uniform and excellent in all respects.

Example 5

In this example the packed static foam generator of this invention was compared to the expensive, commercially available "Oakes Foamer"® to establish the technical advance and progress achieved by our invention. The results obtained showed that our static foam generator produced foams having the same properties and foam densities as are produced using the larger and more expensive "Oakes Foamer"® equipment.

The static foam generator used is the unit described in Example 3. This was compared to a conventional Oakes Foamer. In each instance the liquid foamable formulation was fed into the respective foamer at a feed rate of 200 cc/min. and the air feed was at a rate of

3,000 cc/min. The Oakes Foamer was operated at a nominal speed of 400 rpm. Two of the foam formulations contained water alone, the others contained a wash-wear formulation.

Formulation A - 1 % Foaming Agent I; 1 % Wetting Agent I; 98% water

Formulation B - 2 % poly(ethylene oxide); 98% water

Formulation C - 1 % Foaming Agent I; 1% Wetting Agent I; 79% Permafresh 183; 19% zinc nitrate

Formulation D - 2 % poly(ethylene oxide); 79% Permafresh 183; 19% zinc nitrate

Formulation E - 2 % of the adduct of mixed C_{11}-C_{15} linear secondary alcohols with 40 moles of ethylene oxide; 79% Permafresh 183; 19% zinc nitrate

Formulation F - 2 % alkylaryl sodium sulfonate; 79% Permafresh 183; 19% zinc nitrate

Each formulation was foamed in the static foam generator (SFG) of this invention and the Oakes Foamer, as discussed above, and the results obtained were:

Type of Foamer	Formulation	Inlet Pressure	Foam Density	Half-Life min/sec
SFG	A	24	.070	4/0
Oakes	A	10	.072	4/12
SFG	B	20	.070	2/15
Oakes	B	8	.077	4/11
SFG	C	30	.064	7/0
Oakes	C	16	.066	9/36
SFG	D	26	.064	8/34
Oakes	D	13	.060	9/0
SFG	E	37	.064	16/0
Oakes	E	19	.058	18/0
SFG	F	36	.066	17/0
Oakes	F	16	.060	18/0

Example 6

Three static foam generators (SFG) were assembled, each of different size and evaluated for different feed rates.

SFG I - 2.54 cm in diameter; 15.24 cm in length; packed with the pads described in Example 1.

SFG II - 3.81 cm in diameter; 30.5 cm in length; packed with the pads described in Example 1.

SFG III - 5.08 cm in diamater; 61 cm in length; packed with the pads described in Example 1.

The packing material occupied 12% of the total internal volume of each SFG unit assembled, leaving 88% of the volume free.

The inlet and outlet points of each were equipped as described in Example 1.

A wash-wear formulation was prepared as described in Example 1 and it was fed to each SFG at liquid feed rates of 6,000 cc, 8,000 cc and 10,000 cc per minute while the air flow was adjusted to give the lowest foam density without "blowing" or "burping". Excellent, low density foam was produced under these conditions.

The data was used to determine the Reynolds numbers for each static foam generator at each liquid feed rate using the following equation:

$$\text{Reynolds No.} = \frac{(P)(V)(D)}{\mu}$$

where P = circumference of the tubular reactor

V = velocity

D = diameter of the tubular reactor

μ = dynamic viscosity (cps)

and where V is determined by the equation:

$$V = \frac{(\text{Liquid feed rate})(\text{Blow ratio})}{(\text{Area of tubular reaction})(0.88)}$$

The factor 0.88 represents the free space in the static foam generator and will vary depending upon the degree of packing in any particular generator.

A plot of Reynolds number vs foam density for each size of static foam generator and feed rate can be made and from the curves plotted with the values obtained one can predict the values other than those actually measured.

The results obtained in this series are set forth below:

Feed Rate cc/minute	SFG	Blow Ratio Air/Liquid	Foam Density g/cc	Reynolds Number
10,000	I	6.67	0.150	5,968
"	"	22.22	0.045	19,881
"	"	23.80	0.042	21,295
"	II	9.09	0.110	8,133
"	"	15.62	0.064	13,976
"	"	29.41	0.034	26,315
"	III	4.76	0.210	4,259
"	"	6.25	0.160	5,601
"	"	15.15	0.066	13,555
8,000	I	15.87	0.063	11,360
"	"	7.41	0.135	5,304
"	"	14.71	0.068	10,529
"	II	10.87	0.092	7,780
"	"	21.28	0.047	15,232
"	"	29.41	0.034	21,052
"	III	66.67	0.015	47,723
"	"	13,89	0.072	9,942
"	"	17.54	0.057	12,555
6,000	I	15.87	0.063	8,520
"	"	4.35	0.230	2,335
"	"	16.13	0.062	8,659
"	"			
	II	14.71	0.068	7,897
"	"	24.39	0.041	13,094
"	"	32.26	0.031	17,319
"	III	8.33	0.120	4,472
"	"	17.54	0.057	9,416
"	"	21.28	0.047	11,424

Example 7

To the foam inlet point of the foam application head used in Example 4 there was directly attached a 2.54 cm diameter by 15.24 cm long stainless steel tubular static foam generator. The opposite end of this static foam generator was equipped with the four-way manifold nipple, connected as described in Example 1. The tubular static foam generator was packed with the pads described in Example 1. In addition, the foam distribution chamber of the foam applicator head was packed with sufficient pads desribed in Example 1 so that about 12 % of the total volume of the foam distribution chamber and the static foam generator was occupied by the strands of the pads; the combined total volume of these two components was about 147.7 cubic inches.

Foam was produced using a formulation as described in Example 1 at a liquid feed rate of 6,000 cc/min. and an air feed of 92.3 l/min. It had a density of about 0.065 and it was of good, uniform bubble size that is readily applied to a fabric travelling over the foam applicator head.

It was found that a foam having a density of 0.5 g/cc could be produced by the addition of more packing to the foam distribution chamber at a liquid feed rate of 9,000 cc/min.

Claims:-

1. A static foam generator for the production of foam from a mixture of a liquid treating composition and a gas, which generator comprises a chamber, inlet means at one end of the chamber for the mixture and exit means at an opposite end of the chamber for foam produced in the chamber, wherein from about 10 to 100 percent of the total volume of the chamber contains a packing of random fibers or strands.

2. A foam generator as claimed in claim 1 comprising two or more of the chambers.

3. A foam generator as claimed in claim 1 or claim 2 when integrally united with a known foam applicator head.

4. A foam generator as claimed in claim 1 or claim 2 whose exit means comprises a foam applicator head.

5. A foam generator as claimed in any one of the preceding claims when combined with a known foam generator.

6. A method for the production of foam from a mixture of a liquid treating composition and a gas, which comprises feeding the mixture into the inlet means of a static foam generator as claimed in any one of the preceding claims.

MGB/SJW/MCM/EA101

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 79 302 222.9

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	DD - A - 127 330 (BAYER) * claims 2, 3; page 3 * --	1,2,6	B 01 F 3/04 D 06 B 1/04 //B 01 F 5/00
	GB - A - 1 477 531 (BAYER) * fig. 1 to 6 * --	2-4	
	DE - C - 1 138 023 (ONDERZOEKINGS-INSTITUUT RESEARCH) * claims 1, 2; fig. 6, position 20 * --	1,2,6	TECHNICAL FIELDS SEARCHED (Int.Cl.³)
	DE - A - 2 256 500 (H. SCHLADITZ) * claim 1 * --	1	B 01 F 3/04 B 01 F 5/00 D 06 B 1/04
A	US - A - 4 074 363 (RIC-WIL) * complete document * --		
A	GB - A - 958 556 (A.S. BRITTON) * complete document * ----		

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	22-02-1980	KÜHN