

1 TITLE OF THE INVENTION

Method for textile printing

BACKGROUND OF THE INVENTION

5 Field of the Invention

This invention relates to a method for textile printing by ink jet process, and more particularly to a method for textile printing by ink jet process, characterized by using specific, pretreated cloth.

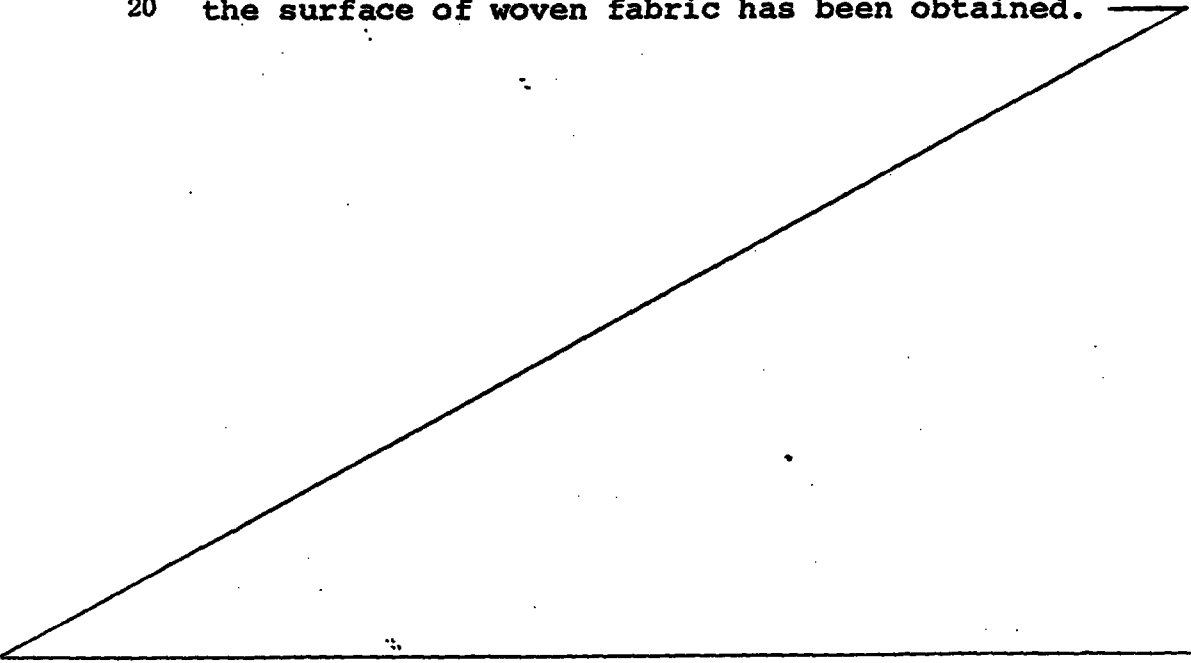
Description of the Prior Art

In the printing of cloth such as woven or non-woven fabrics of various fibers or mix-spun fabric, various printing methods such as roller printing, screen printing, transfer printing, etc. have been so far employed, and further a method for textile printing by ink jet process has been proposed for certain uses.

These conventional, ordinary methods for textile printing require print plates and the preparation of these plates such as plate drums or screen plates are expensive or even in the transfer printing the preparation of plates for printing transfer paper is also expensive, so that the preparation does not pay from the viewpoint of cost, unless the plates are produced in a large quantity. Furthermore, the period of fashion of print cloth patterns

1 is generally so short that the preparation of the
plates at each occasion of change in fashion leads to
a further cost increase, resulting in a failure to
rapidly meet the fashion tendency, and this will
5 lead to a high possibility of stockpiles of an
enormous amount of out-of-day prints.

To overcome these disadvantages, textile
printing by an ink jet process is proposed.
However, in the textile printing by ink jet process,
10 a recording liquid (ink) of high viscosity such as
the conventional printing paste cannot be employed,
and in the case of printing woven fabrics, etc., the
ink retainability of the surface of woven fabric is
poor, and also owing to the presence of texture, the
15 deposited ink is liable to spread, so that it is
difficult to form a precise print pattern. Further-
more, even if fixing of the deposited dye is effected
after the printing, neither distinguished levelling
property nor high fixation efficiency of the dye on
20 the surface of woven fabric has been obtained.

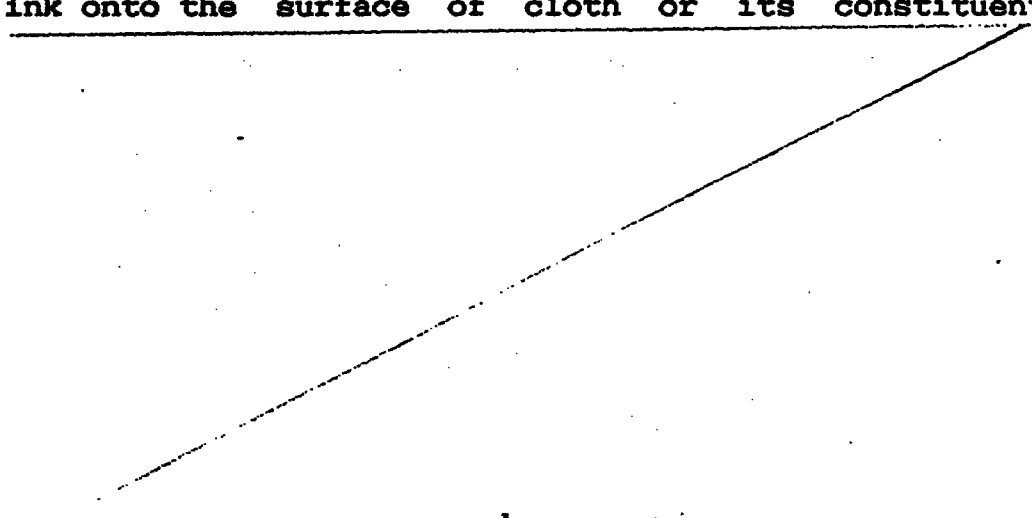


SUMMARY OF THE INVENTION

According to the present invention, there is provided a method of printing using an aqueous jet-ink containing a dye, the method comprising the steps of applying to a cloth or its constituent fibres a film 0.5 to 30 μ m thick of an ink acceptor comprising a water-soluble polymer or hydrophilic polymer capable of rapidly absorbing the aqueous jet-ink, depositing the aqueous jet-ink on the cloth by ink-jet printing, and removing the ink acceptor after the dye is fixed on the cloth.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The main feature of the present invention resides in a method for textile printing by ink jet process, which comprises depositing an acceptor for ink onto the surface of cloth or its constituent



1 fibers as a material to be printed, the acceptor
being capable of easily and rapidly absorbing and
accepting the ink as a recording liquid of ink jet
process, and then depositing a jet ink thereon.

5 The cloth for use in the present invention
which mainly characterizes the present invention
includes cloth made of fibers dyeable with a water-
soluble dye such as natural fibers, for example,
cotton, wool, silk, hemp, etc.; regenerated fibers,
10 for example, cupra, rayon, etc.; synthetic fibers,
for example, acryl, nylon, etc., or mix-spun cloth
of these different fibers or these fibers with other
fibers, such as fibers of polyester, vinylon, poly-
propylene, acetate, triacetate, etc. In the present
15 invention, the cloth or fibers constituting the cloth
is pretreated so as to rapidly and easily absorb and
accept an ink for the ink jet process.

The present inventor has found that the said
disadvantages of the prior art, particularly the
20 problem encountered when an ink of low viscosity for
the ink jet process can be easily solved by providing
an ink acceptor having the said property on cloth
as a material to be printed, and has established the
present invention.

25 Preferable material for the acceptor includes
water-soluble or hydrophilic natural or synthetic
polymers, and preferable examples are natural

1 compounds and their modified products or their
derivative by chemical reaction, such as wheat flour,
rice powder, rice bran, funorin, albumin, gelatin,
casein, starch, cellulose, gum arabic, tragacanth gum,
5 locust bean gum, sodium alginate, bentonite, etc.
and synthetic resins and their modified products or
their derivatives such as water-soluble polyamide,
polyacrylamide, quaternarized polyvinylpyrrolidone,
polyethyleneimine, polyvinyl-pyridinium halide,
10 melamine resin, polyurethane, polyvinyl alcohol,
water-soluble polyester, sodium polyacrylate, etc.,
and at least one of these materials is used as
required. Furthermore, to reinforce the strength of
the ink acceptor and/or to improve the adhesion of
15 the ink acceptor to a substrate, it is possible to
use a resin as a binder such as SBR latex, NBR latex,
polyvinylformal, polymethyl methacrylate, polyvinyl-
butyral, polyacrylonitrile, polyvinyl chloride,
polyvinyl acetate, phenol resin, alkyd resin, etc.,
20 if required.

The ink acceptor is deposited on the cloth by
dissolving or dispersing the said polymer individually
or their mixture in an appropriate solvent, thereby
preparing a treating liquid, and treating cloth or
25 fibers constituting the cloth with the treating
liquid according to the known process, for example,
by dipping, spraying, roll coating, rod-bar coating,

1 air knife coating or the like. The treatment can be
carried out on the yarns or fibers before weaving
(the treated yarns or fibers are woven thereafter) or
on woven cloth. The treatment can be carried out in
5 advance to the printing or just before the printing.

The thickness of the ink acceptor coating
film thus formed must be in such a range as to accept
the ink, and is desirably at least 0.1 μm , though
dependent on the quantity of the ink to be deposited,
10 and practically is in a range of 0.5 to 30 μm .

When the thickness exceeds 30 μm , the fixation
efficiency of the dye in the dye-fixing step is
deteriorated, and the dye-fixing time is prolonged,
resulting in a cost increase. When the thickness is
15 less than 0.5 μm on the other hand, formation of
precise print pattern or an increase in the fixation
efficiency of the dye cannot be attained. The
adjustment of thickness can be easily carried out by
controlling a polymer concentration in the treating
20 liquid in the step of forming the ink acceptor
coating film.

When the ink acceptor is deposited on the
surface of cloth or fibers constituting the cloth and
when the ink is deposited on the cloth by ink jet
25 process. The deposited ink is absorbed and accepted
by the ink acceptor within 3 minutes, and thus the
ink dots will not excessively spread on the cloth.

1 Thus, precise printing and a high fixation efficiency
of the dye can be attained in the successive dye-
fixing treatment. Furthermore, since the deposited
ink can be absorbed and accepted within such a short
5 time, there will be no staining of other material,
even if brought into contact with the printed surface,
and the printed cloth can be laid one upon another or
wound up immediately after the printing, and thus
can be preserved in any form till the successive
10 dye-fixing treatment.

On the other hand, when cloth without any
coating of the ink acceptor is used as cloth to be
printed, the applied ink dots are excessively spread,
because the ink for ink jet process is usually an
15 aqueous solution of low viscosity, whereas various
fibers constituting cloth are not always completely
hydrophilic, for example, fibers of nylon, wool, silk,
cotton, etc. and also owing to the presence of
texture of cloth. Thus it is difficult to form a
20 precise pattern. Furthermore the fixation efficiency
of the dye is low in the dye-fixing step. Even if
cloth is relatively hydrophilic such as cotton, it is
not always so hygroscopic as to absorb the ink within
a short time, for example, within 3 minutes, and
25 transfer the ink to other material, even if brought
in contact with the printed surface. Other fibers
than the cotton fibers are poor in the hygroscopic

1 property, and their handling, such as winding,
immediately after the printing is quite difficult to
conduct. These problems of the prior art has been
completely solved in the present invention.

5 As to the dye for the ink for ink jet process
to be used in the present invention, any of the so far
known dyes can be used, but it is preferable to select
it in view of the species of fibers constituting the
clotch as a material to be printed. For example, in
10 the case of cellulose-based fibers such as cotton,
hemp, viscose, etc., direct dyes, reactive dyes,
sulfur dyes in the reduced form, naphthol dyes, vat
dyes in the reduced form, soluble vat dyes, etc. can
be used. Particularly preferable are direct dyes
15 such as C.I. Direct Yellow 8, 9, 11, 12, 27, 28, 29,
33, 35, 39, 41, 44, 50, 53, 58, 59, 68, 86, 87, 93,
95, 96, 98, 100, 106, 108, 109, 110, 130, 132, 142,
144, 161, 163; C.I. Direct Orange 6, 15, 18, 26,
29, 34, 37, 39, 40, 41, 46, 49, 51, 57, 62, 71, 105,
20 107, 115; C.I. Direct Red 2, 4, 9, 23, 26, 31, 39,
62, 63, 72, 75, 76, 79, 80, 81, 83, 84, 89, 92, 95,
111, 173, 184, 207, 211, 212, 214, 218, 221, 223,
224, 225, 226, 227, 232, 233, 240, 241, 242, 243,
247; C.I. Direct Violet 7, 9, 47, 48, 51, 66, 90, 93,
25 94, 95, 98, 100, 101; C.I. Direct Blue 1, 10, 15, 22,
25, 55, 67, 68, 71, 76, 77, 78, 80, 84, 86, 87, 90,
98, 106, 108, 109, 151, 156, 158, 159, 160, 168, 189,

1 192, 193, 194, 199, 200, 201, 202, 203, 207, 211,
213, 214, 218, 225, 229, 236, 237, 244, 248, 249,
251, 252, 264, 270, 280, 288, 289, 291; C.I. Direct
Green 26, 27, 28, 29, 30, 31, 33, 34, 59, 63, 65,
5 66, 67, 68, 74, 80, 85, 89; C.I. Direct Brown 44,
98, 100, 103, 106, 113, 115, 116, 157, 169, 170, 172,
195, 200, 209, 210, 212, 221, 222, 223, 227, 228,
229; C.I. Direct Black 9, 17, 19, 22, 32, 51, 56, 62,
69, 77, 80, 91, 94, 97, 108, 112, 113, 114, 117, 118,
10 121, 122, 125, 132, 146, 154, 166, 173, 199;
Kayacelon Red C-HB, Kayacelon Rubin C-BL; Kayacelon
Blue C-G, etc.; and reactive dyes such as C.I.
Reactive Yellow 2, 3, 13, 14, 15, 17, 18, 23, 24, 25,
26, 27, 29, 35, 37, 41, 42, 49, 50, 52, 54, 55, 57,
15 58, 63, 64, 75, 76, 77, 79, 81, 82, 83, 84, 85, 87,
88, 91, 92, 93, 95, 96, 111, 115, 116, 131, 135;
C.I. Reactive Orange 5, 7, 10, 11, 12, 13, 15, 16,
20, 30, 34, 35, 41, 42, 44, 45, 46, 56, 57, 62, 63,
64, 67, 69, 71, 72, 73, 74, 78, 82, 84, 87; C.I.
20 Reactive Red 3, 13, 17, 19, 21, 22, 23, 24, 29, 35,
37, 40, 41, 43, 45, 49, 55, 56, 58, 63, 67, 80, 81,
82, 85, 86, 87, 104, 106, 108, 109, 110, 111, 112,
113, 114, 117, 118, 119, 120, 123, 124, 126, 128,
130, 131, 132, 141, 147, 158, 159, 170, 171, 174, 176;
25 C.I. Reactive Violet 1, 3, 4, 5, 6, 7, 8, 9, 16, 17,
22, 23, 24, 26, 27, 33; C.I. Reactive Blue 2, 3, 5, 8,
10, 13, 14, 15, 17, 18, 19, 21, 25, 26, 27, 28, 29,

1 38, 39, 40, 42, 43, 49, 51, 52, 65, 66, 67, 68, 71,
73, 74, 75, 77, 78, 79, 80, 89, 98, 100, 101, 104,
105, 112, 113, 114, 116, 119, 147, 148, 158, 160,
162, 169, 170, 171, 179, 182, 187; C.I. Reactive
5 Green 5, 8, 12, 14, 15, 16, 19, 21; C.I. Reactive
Brown 2, 5, 6, 7, 8, 9, 16, 17, 18, 19, 21, 24, 26,
30; C.I. Reactive Black 4, 5, 8, 14, 21, 23, 26, 31,
32, 34; and the individual dyes in Kayacelon React
series (Nihon Kayaku K.K., Japan). Onto mix-spun
10 fabrics of cotton with other fibers are deposited
the same dyes as described above.

When the fibers are of protein such as wool,
silk, nylon, etc. or of polyamide, acid dyes, chrome
dyes (acid mordant dyes), reactive dyes, soluble vat
15 dyes, sulfur dyes in the reduced form, naphthol dyes,
etc. can be employed. Particularly preferable are
acid dyes such as C.I. Acid Yellow 17, 19, 25, 39,
40, 42, 44, 49, 50, 61, 64, 76, 79, 110, 127, 135,
143, 151, 159, 169, 174, 190, 195, 196, 197, 199, 218,
20 219, 222, 227; C.I. Acid Orange 3, 19, 24, 28:1, 33,
43, 45, 47, 51, 67, 94, 116, 127, 138, 145, 156;
C.I. Acid Red 35, 42, 57, 62, 80, 82, 111, 114, 118,
119, 127, 128, 131, 143, 151, 154, 158, 249, 257,
261, 263, 266, 299, 301, 336, 337, 361, 396, 397;
25 C.I. Acid Violet 5, 34, 43, 47, 48, 90, 103, 126;
C.I. Acid Blue 25, 40, 41, 62, 72, 76, 78, 80, 82, 92,
106, 112, 113, 120, 127:1, 129, 138, 143, 175, 181,

- 1 205, 207, 220, 221, 230, 232, 247, 258, 260, 264,
271, 277, 278, 279, 280, 288, 290, 326; C.I. Acid
Green 16, 17, 19, 20, 25, 28, 40, 41, 71; C.I. Acid
Brown 4, 248; C.I. Acid Black 7, 24, 29, 48, 52:1,
5 172, etc. acid reactive dyes such as C.I. Reactive
Yellow 21, 34, 39, 69, 98, 125, 127; C.I. Reactive
Orange 29, 53, 68; C.I. Reactive Red 28, 65, 66, 78,
83, 84, 100, 116, 136, 147, 154, 172; C.I. Reactive
Violet 34; C.I. Reactive Blue 50, 69, 94, 177;
10 C.I. Reactive Brown 12, etc. When the fibers are of
acryl, it is preferable to use basic dyes such as
C.I. Basic Yellow 1, 2, 4, 11, 13, 14, 15, 19, 21, 23,
24, 25, 28, 29, 32, 36, 39, 40, 45, 49, 51, 56, 61,
63, 67, 70, 71, 73, 77, 82, 85, 87, 91, 92; C.I.
15 Basic Orange 21, 22, 27, 28, 29, 30, 36, 40, 42, 43,
44, 46, 47, 57, 58; C.I. Basic Red 12, 13, 14, 15,
18, 22, 23, 24, 25, 27, 29, 35, 36, 38, 39, 45, 46,
51, 52, 54, 59, 60, 61, 68, 69, 71, 74, 75, 78, 80,
81, 82, 95, 100, 102, 103, 104, 109; C.I. Basic
20 Violet 1, 2, 3, 7, 10, 15, 16, 20, 21, 25, 27, 28,
35, 37, 39, 40, 48; C.I. Basic Blue 1, 3, 5, 7, 9,
22, 26, 41, 45, 46, 47, 54, 57, 60, 62, 65, 66, 69,
71, 75, 77, 78, 85, 89, 92, 93, 95, 96, 105, 109,
116, 117, 120, 122, 124, 137, 141; C.I. Basic Green 1,
25 4, 6, 8, 9; C.I. Basic Brown 14; C.I. Basic Black 8,
etc.

When the cloth to be printed comprises

1 synthetic fibers and/or semi-synthetic fibers as the
main component, it is preferable to use disperse dyes
as a dye for the ink. So far known disperse dye can
be employed, but particularly preferable are C.I.
5 Disperse Yellow 5, 42, 56, 64, 76, 79, 83, 100, 124,
140, 160, 162, 163, 164, 165, 186, 192, 224; C.I.
Disperse Orange 13, 29, 30, 31, 33, 43, 49, 50, 55,
61, 73, 78, 119; C.I. Disperse Red 43, 54, 56, 72,
73, 76, 88, 91, 92, 93, 103, 111, 113, 126, 127,
10 128, 135, 143, 145, 152, 153, 154, 164, 181, 188,
189, 192, 203, 205, 206, 207, 221, 224, 225, 227,
257, 258, 288, 296; C.I. Disperse Violet 27, 35, 38,
46, 52, 56; C.I. Disperse Brown 1, 9; C.I. Disperse
Blue 54, 60, 73, 87, 94, 113, 128, 139, 142, 143,
15 146, 148, 149, 158, 167, 176, 183, 186, 187, 197,
198, 201, 205, 207, 211, 214, 224, 225, 257, 259,
267, 268, 270, 301; Kayacelon Red E-GL, Kayacelon
Blue E-TB, etc.

When the cloth to be printed is a mix-spun
20 fabric of other fibers such as cotton, silk, hemp,
wool or other natural fibers, dyes for these natural
fibers, such as direct dyes, acid dyes, chrome dyes
(acid mordant dyes), reactive dyes, vat dyes in the
reduced form, soluble vat dyes, sulfur dyes in the
25 reduced form, naphthol dyes, etc. can be employed
together with the disperse dye.

The ink for the ink jet process for use in the

1 present invention can be prepared by dissolving or
dispersing the dye as mentioned above in a medium to
a concentration of about 0.1 to about 15% by weight.
The ink medium is water alone, or preferably a mixture
5 of water and a water-soluble organic solvent. The
organic solvent for use in the present invention
includes alkyl alcohols having 1 to 4 carbon atoms
such as methyl alcohol, ethyl alcohol, n-propyl
alcohol, isopropyl alcohol, n-butyl alcohol, sec-butyl
10 alcohol, tert-butyl alcohol, isobutyl alcohol, etc.;
amides such as dimethyl formamide, dimethyl acetamide,
etc.; ketones or ketoalcohols such as acetone,
diacetone alcohol, etc.; ethers such as tetrahydrofuran,
dioxiane, etc.; polyalkylene glycols such as poly-
15 ethylene glycol, polypropylene glycol, etc.; alkylene
glycols with an alkylene group having 2 to 6 carbon
atoms, such as ethylene glycol, propylene glycol,
butylene glycol, triethylene glycol, 1,2,6-hexanetriol,
thiodiglycol, hexylene glycol, diethylene glycol, etc.;
20 glycerine; lower alkyl ethers of polyhydric alcohol
such as ethylene glycol methyl (or ethyl) ether,
diethylene glycol methyl (or ethyl) ether, triethylene
glycol monomethyl (or ethyl) ether, etc.; N-methyl-2-
pyrrolidone, 1,3,-dimethyl-2-imidazolidinone, etc.

25 The said medium can be used individually or
in a mixture, but the most preferable medium composi-
tion comprises water and at least one of water-soluble

1 organic solvent, and the water-soluble solvent
contains at least one of water-soluble, high boiling
organic solvents, for example, polyhydric alcohols
such as ethylene glycol, propylene glycol, glycerine,
5 etc. The medium is used so that the content of the
said dye may be about 0.1 to about 15% by weight,
when the ink composition is prepared.

An ink containing a disperse dye can be
generally prepared by mixing the essential components
10 and optional components as described above, subjecting
the mixture to mixing-milling treatment by a so far
well known means such as a ball mill, sand mill,
speed line mill, etc., if necessary, adjusting the
concentration with a medium, and adjusting the pH
15 finally to 4 - 10. The particle size of the disperse
dye is usually not more than about 30 μ m, preferably
not more than about 20 μ m. When the particle size is
too large, there will be problems of nozzle clogging,
etc. during the ink jet recording, or in the levelling
20 property in the successive dye-fixing step. When a
medium capable of dissolving a disperse dye is
selected, the present ink composition can be obtained
only by utilizing mere dissolving action, such as
heating, etc.

25 The essential components for the ink composi-
tion to be used in the present invention are as
described above, but various so far known dispersants,

1 surfactants, viscosity-controlling agents, etc. can
be added thereto, if required.

Important dispersant or surfactant to be added
to the essential components, if required, are
5 anionic dispersants or surfactants such as fatty acid
salts, alkyl sulfate ester salt, alkylbenzene
sulfonate salt, alkyl naphthalene sulfonate salt,
dialkyl sulfosuccinate salt, alkyl phosphate ester
salt, naphthalene sulfonate-formalin condensate,
10 polyoxyethylenealkyl sulfate ester salt, etc.;
non-ionic dispersants or surfactants such as poly-
oxyethylenealkyl ether, polyoxyethylenealkylphenyl
ether, polyoxyethylene fatty acid ester, sorbitane
fatty acid ester, polyoxyethylene sorbitane fatty
15 acid ester, polyoxyethylenealkylamine, glycerine
fatty acid ester, oxyethyleneoxypropylene block
copolymer, etc.

Preferable viscosity-controlling agent
includes natural or synthetic water-soluble polymers
20 such as carboxymethylcellulose, sodium polyacrylate,
polyvinylpyrrolidone, gum arabic, starch, etc. The
viscosity of the present ink composition is adjusted
to not more than 50 cps, preferably 1 to 10 cps at
25°C with or without the viscosity-controlling agent.

25 Beside the foregoing three additives, for
example, a defoaming agent, a permeating agent,
antiseptics, a pH-controlling agent, etc. can be added

1 thereto, if required.

Futhermore, a resistivity-controlling agent such as lithium chloride, ammonium chloride, or sodium chloride is added thereto to prepare an ink
5 for the ink jet recording process of ink-electro-charging type. When an ink is applied to an ink jet process of injecting an ink under the action of thermal energy, thermal physical properties (e.g. specific heat, coefficient of thermal expansion,
10 thermal conductivity, etc.) must be adjusted.

Any ink jet recording process can be used in the present invention, so far as it can effectively release the ink composition from the nozzle and deposit the ink onto cloth to be printed. Typical
15 of the process are those disclosed, for example, in IEEE Transactions on Industry Applications Vol. JA-13, No. 1, (February and March issues, 1977) and Nikkei Electronics No. 305 (December 16 issue, 1982). The processes disclosed therein are suitable for the
20 present method for textile printing, some of which will be described below.

A first process is an electrostatic attraction process including a system of successively discharging from a nozzle an ink as changed into particulates
25 under a strong electric field given between the nozzle and an accelerating electrode provided a few mm before the nozzle and giving an information signal

1 to deviating electrodes while the discharged ink
composition is flying between the deviating electrodes,
thereby conducting recording, and also including a
system of injecting ink particulates in accordance
5 with an information signal without deviating the ink
particulates. Any of these systems is effective for
the present method for textile printing.

A second process is to give a high pressure
to an ink by a small pump and injecting fine ink
10 particles forcedly while mechanically vibrating the
nozzle by a quartz oscillator, where the injected ink
particles are electrically charged in accordance with
an information signal at the same time when injected,
and the electrically charged ink particles are
15 deviated in accordance with the quantity of charged
electricity during the passage between the deviating
electrodes. Another process utilizing the said process
is the one called "microdot ink jet process, where two
kinds of ink droplets, i.e. larger droplets and smaller
20 droplets, are generated at the tip end of nozzle by
keeping the ink pressure and exciting conditions in
appropriate ranges, respectively, and only smaller
droplets are utilized for recording. This process
can characteristically produce groups of fine droplets
25 even through a nozzle having a large diameter such as
the conventional nozzle.

A third process is a process using a piezo

1 device, where a piezo device is used as a pressurizing
means for the ink in place of the mechanical means
such as a pump in other processes. An ink is
injected while giving the ink a pressure generated
5 by giving an electric signal to the piezo device,
thereby causing a mechanical displacement.

Furthermore, an ink jet process disclosed in
Japanese Patent Application Kokai (Laid-open) No.
54-51837 can be effectively used, where an ink under
10 an action of thermal energy undergoes rapid volumic
expansion and is discharged from the nozzle by the
force exerted by the change of the state.

Any of various ink jet recording processes
as described above can be used to form image patterns
15 such as letters, figures, etc. of colored ink composi-
tion on the surface of cloth having the specific
composition as described above. In the present
method, the ink dots deposited on the cloth can be
rapidly absorbed and maintained in the ink acceptor
20 on the cloth before excessive spreading, and thus
patterns can be formed, as described above and the
fixation efficiency of the dye is also high in the
dye-fixing step. The state similar to a dry state
can be obtained within 3 minutes after the printing,
25 and thus the printed cloth can be laid one upon
another or wound up immediately.

Thus, a clear and fine image pattern can be

1 formed also through the successive dye-fixing step
by heat treatment, etc. On the other hand, in the
case of the conventional cloth, it is difficult to
form fine image patterns thereon owing to the
5 spreading of the ink on the cloth due to the use of
an ink of low viscosity and hydrophobic cloth.

As described above, an ink composition can be
deposited on cloth according to an image signal in the
present method, and the dye in the ink composition in
10 that state is merely absorbed and maintained in the
ink acceptor on the surface of cloth. Thus, it is
preferable to conduct successive dye-fixing treatment
by heating, etc. The dye-fixing treatment depends on
the species of dye and cloth used, but can be
15 appropriately selected from steaming with overheated
steam, heating with warm or hot water, dry heating,
soaping with an aqueous surfactant solution, etc.
By the dye-fixing treatment, the dye in the ink
acceptor is thoroughly fixed to the fibers of cloth,
20 and the water-soluble ink acceptor is removed by water
washing in the soaping treatment, etc., and the
printed cloth of distinguished quality can be
obtained.

In the present invention, as described above,
25 preparation of expensive print plates as in the
conventional, ordinary textile printing is unnecessi-
tated in the textile printing, and the patterns to be

1 printed can be very simply prepared and adjusted by
a computer. Thus, the present invention can rapidly
correspond to a change in fashion tendency at any
time without requiring any expensive plate as in the
5 prior art. That is, the present invention can assure
an enough profit even in the production in a small
scale without any production in a large scale as in
the prior art. Furthermore, the present invention
is applicable, with advantages, not only to the
10 industrial scale textile printing, but also to home
hobby textile printing.

The present invention will be described in
detail below, referring to Examples, where parts and
% are by weight.

15 Ink Preparation Example 1A

Direct dye (C. I. Direct Blue 291)	5 parts
Glycerine	5 parts
Diethyleneglycol	13 parts
Ethylene glycol	17 parts
20 Water	65 parts

All the foregoing components were stirred for
about 5 hours, and pH was adjusted to 8.2 with sodium
hydroxide, and the mixture was filtered through
Fluoropore Filter FP-100 (made by Sumitomo Denko
25 K.K., Japan) under pressure, whereby an aqueous ink
(A) was obtained.

1 Ink Preparation Example 2A

Acid dye (C. I. Acid Red 263)	6 parts
Polyethyleneglycol 300	10 parts
Diethyleneglycol	20 parts
5 Anionic surfactant (Demol N, by Kao Soap Co., Ltd., Japan)	0.5 parts

All the foregoing components were stirred for about 3 hours, and the mixture was filtered through Fluoropore Filter FB-100 (made by Sumitomo Denko K.K.,
10 Japan) under pressure, whereby an aqueous ink (B) was obtained.

Ink Preparation Example 3A

Reactive dye (C. I. Reactive Orange 53)	4 parts
Nonionic surfactant (Nikkol NP15, made by Nikko Chemicals K.K. Japan)	0.1 parts
15 Diethyleneglycol	30 parts
Water	70 parts

All the foregoing components were treated in the same manner as in Preparation Example 2A, whereby
20 an aqueous ink (C) was obtained.

Ink Preparation Example 4A

Basic dye (C. I. Basic Blue 3)	5 parts
Ethanol	20 parts
Polyethyleneglycol 400	10 parts
25 Water	70 parts

All the foregoing components were treated in the same manner as in Preparation Example 2A,

1 whereby an aqueous ink (D) was obtained.

Ink Acceptor Preparatory Example 1A

Tragacanth gum	0.5 parts
Carboxymethylcellulose	0.1 parts
5 Water	99.4 parts

All the foregoing components were stirred at room temperature for 24 hours, and further at 80°C for 2 hours, and then cooled, whereby a preparatory solution was obtained. Cloth to be printed was
10 treated with the preparatory solution by dipping, and squeezed through rollers, and dried, whereby an ink acceptor layer was formed on the cloth to a thickness of 5 μ m.

Ink Acceptor Preparation Example 2A

15 Sodium alginate	1 part
Polyvinylformal	0.2 parts
Water	98.8 parts

All the foregoing components were stirred at room temperature for 24 hours, then boiled and
20 cooled, whereby a preparatory solution was obtained. Cloth to be printed was treated with the preparatory solution by dipping, squeezed through rollers, and dried, whereby an ink acceptor layer was formed on the cloth to a thickness of 3 μ m.

25 Ink Acceptor Preparation Example 3A

Etherified locust bean gum	0.2 parts
Starch	0.1 part

1 Polyvinylpyrrolidone 0.1 part
 Water 98 parts

 All the foregoing components were treated in
the same manner as in Ink Acceptor Preparation

5 Example 2A, and an ink acceptor layer was formed on
the cloth to a thickness of 2 μ m.

Examples 1 to 4

 While cloth sheets treated in Ink Acceptor
Preparatory Examples 1A to 3A were printed with the
10 inks of Ink Preparatory Examples 1A to 4A. The
results are shown in Table 1.

 Printing was carried out in a printer
utilizing a piezo device (nozzle diameter: 65 μ m,
PJ-1080A made by Canon Corporation, Japan), and then
15 fixing (dye-fixing) was carried out. To remove the
acceptor, the cloth sheets were washed with water, and
the grade of printed cloth sheets was visually judged
after drying.

Comparative Example 1

20 Printing was carried out in the same manner as
in Examples 1 to 4 without any ink acceptor layer in
the combinations shown in Table 1. It was found that
the printed cloth sheets were poor in items such as
density, color tone, strike-through, and edge sharp-
25 ness, particularly as compared with the cloth sheets
with the ink acceptor layer.

1

Table 1

Example No.	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Ink	Ink A	Ink B	Ink C	Ink D
Cloth	cotton 100%	silk 100%	wool 80% polyester 20%	acryl 80% wool 20%
5	broadcloth	habutae	gaberdine	broadcloth
Ink acceptor	Prep. Ex. 1A	Prep. Ex. 2A	Prep. Ex. 3A	Prep. Ex. 4A
Color Density*	good	good	good	good
10 Color tone*	good	good	good	good
Color eveness*	good	good	good	somewhat good
Strike- through*	Sub- stantially none	Sub- stantially none	Sub- stantially none	Sub- stantially none
15 Edge sharpness	good	good	good	good
<u>Overall evaluation</u>	good	good	good	good

* Each judgement was made from all-over print (about
2 x 2 cm²) and line print (about 1 mm wide and about
20 cm long) made on the cloth by a printer.

Ink Preparation Example 1B

Disperse dye (C. I. Disperse Blue 187) 5 parts

25 Anionic surfactant (Dispersant)
(Demol N, made by Kao Soap Co., Ltd.,
Japan) 4 parts

Ethyleneglycol 15 parts

1	Diethyleneglycol	13 parts
	Water	65 parts

5 All the foregoing components were dispersed
in an alumina ball mill for about 36 hours, and pH was
adjusted to 8.3 with sodium hydroxide. Then, the
mixture was dispersed with an alumina ball mill for
3 hours, and then filtered through Fluoropore Filter
FP-1000 (made by Sumitomo Denko K.K., Japan) to remove
10 coarse particles having particle sizes of more than
10 μ m, whereby an aqueous ink (E) of the present
invention was prepared.

Ink Preparatory Example 2B

	Disperse dye (C. I. Disperse Yellow 78)	5 parts
15	Anionic surfactant (Ionet D-2, made by Sanyo Kasei Kogyo K.K., Japan)	4 parts
	Diethyleneglycol	15 parts
	Triethyleneglycol monomethyl ether	10 parts
	Water	70 parts

20 All the foregoing components were dispersed
with an alumina ball mill for about 36 hours, and
pH was adjusted to 7.6 with sodium hydroxide, and
then the mixture was further dispersed with a
homogenizer for 2 hours. Then, the mixture was
25 centrifuged to remove coarse particles, whereby an
aqueous ink (F) was obtained.

1	Ink Preparatory Example 3B		
	Disperse dye (C. I. Disperse Red 11)	4 parts	
	Anionic surfactant (Nikkol OTP-100s, made by Nikko Chemicals, K.K., Japan)	0.5 parts	
5	Anionic surfactant (Demol C, made by Kao Soap Co., Ltd., Japan)	1.5 parts	
	Nonionic surfactant (Emulgen 911, made by Kao Soap Co., Ltd., Japan)	0.2 parts	
	Isopropyl alcohol	0.5 parts	
	Propyleneglycol	15 parts	
10	Polyethyleneglycol	5 parts	
	Water	75 parts	

All the foregoing components were dispersed in an alumina ball mill for about 40 hours, and pH was adjusted to 7.4 with potassium hydroxide, and then the mixture was further dispersed for two hours. Then, the mixture was filtered through Fluoropore Filter FP-500 (made by Sumitomo Denko K.K., Japan) to remove coarse particles having particle sizes of more than 5 μ m, whereby an aqueous ink (G) was obtained.

20	Ink Acceptor Preparation Example 1B		
	Locust bean gum	0.2 parts	
	Polyvinylformal	0.05 parts	
	Water	99.75 parts	

25 All the foregoing components were stirred for 24 hours, boiled, and then cooled to obtain a

1 preparatory solution. Cloth sheets to be printed
were treated with the preparatory solution by dipping,
squeezed through rollers and dried, whereby an ink
acceptor was formed on the cloth sheets to a thickness
5 of 10 μm .

Ink Acceptor Preparation Example 2B

Sodium alginate	1 part
Carboxymethylcellulose	0.1 part
Polyvinyl acetate	0.1 part
10 Water	98.8 parts

An ink acceptor was formed on cloth sheets
to be printed from all the foregoing components in
the same manner as in Ink Acceptor Preparation Example
1B to a thickness of 13 μm .

15 Examples 5 to 7

White cloth sheets treated in Ink Acceptor
Preparation Examples 1B and 3B were printed with inks
of Ink Preparation Examples 1B to 3B. Results of
printing are shown in Table 2.

20 Printing was carried out in a printer
utilizing a piezo device (nozzle diameter: 65 μm ,
PJ-1080A, made by Canon K.K., Japan), and then fixing
(dye-fixing) was carried out. To remove the acceptor,
the cloth sheets were washed with water, and the grade
25 of printed cloth sheets was visually judged after
drying.

1 Comparative Example 2

Printing was carried out in the same manner as in Examples 5 to 7 without any ink acceptor in the combinations shown in Table 2. It was found that the
5 printed cloth sheets were poor in items such as density, color tone, strike-through, and edge sharpness, particularly as compared with the cloth sheets with the ink acceptor.

Table 2

10	Example No.	<u>5</u>	<u>6</u>	<u>7</u>
	Ink	Ink E	Ink F	Ink G
	Cloth	polyester 100% georgette	acetate 100% broadcloth	polyester 65% cotton 35% broadcloth
15	Ink acceptor	Prep. Ex. 1B	Prep. Ex. 2B	Prep. Ex. 1B
	Color Density*	good	good	good
	Color tone*	good	good	good
	Color evenness*	good	good	good
20	Strike-through*	substantially none	substantially none	substantially none
	Edge sharpness*	somewhat good	good	good
	Overall evaluation	good	good	good

* Each judgement was made from all-over print

25 (about 2 x 2 cm²) and line print (about 1 mm wide and about 20 cm long) made on the cloth by a printer.

1 Ink Acceptor Preparation Examples 1C to 6C

In Preparation Examples 1C to 3C shown in Table 3, all the components were stirred at room temperature for 24 hours, further stirred at 80°C
5 for 2 hours and then cooled to prepare preparatory solutions. Cloth sheets to be printed were treated with the thus prepared preparatory solution by dipping, squeezed through rollers and dried to form ink acceptors on the cloth sheets to be printed.

10 In Preparation Examples 4C to 6C, all the components shown in Table 3 were stirred at room temperature for 24 hours, then boilded, and cooled to prepare preparatory solutions. Cloth sheets to be printed were treated with the thus prepared prepara-
15 tory solutions by dipping, squeezed through rollers and dried to form ink acceptors on the cloth sheets to be prepared.

Examples 8 to 13

White cloth sheets treated in Ink Acceptor
20 Preparation Examples 1C to 6C were printed with the inks of Ink Preparatory Examples 1A to 2A. Results of printing are shown in Table 4.

Printing was carried out in a printer utilizing a piezo device (nozzle diameter: 65 μ m,
25 PJ-1080A, made by Canon K.K., Japan), and then fixing (dye-fixing) was carried out. To remove the acceptor, the cloth sheets, were washed with water, and the

1 quality of the print of the cloth sheets was visually judged after drying.

Table 3

5	<u>Ink Acceptor Preparation Ex. No.</u>	<u>1C</u>	<u>2C</u>	<u>3C</u>
	Tragacanth gum	0.01 parts	0.5 parts	1.5 parts
	Carboxymethyl- cellulose	0.002 parts	0.1 parts	0.3 parts
10	Water	99.988 parts	99.4 parts	98.2 parts
	<u>Ink Acceptor Preparation Ex. No.</u>	<u>4C</u>	<u>5C</u>	<u>6C</u>
	Sodium alginate	0.02 parts	1 part	3 parts
15	Polyvinylformal	0.004 parts	0.2 parts	0.6 parts
	Water	99.976 parts	98.8 parts	96.4 parts

20

25

Table 4

<u>Example No.</u>	<u>8</u>	<u>9</u>	<u>10</u>
<u>Ink</u>	<u>Ink A</u>	<u>Ink A</u>	<u>Ink A</u>
<u>Cloth</u>	cotton 100% broadcloth	cotton 100% broadcloth	cotton 100% broadcloth
<u>Ink Acceptor</u>	Prep. Ex. 1C	Prep. Ex. 2C	Prep. Ex. 3C
Thickness of acceptor (μm)*	0.5	20	30
Color Density**	good	good	somewhat good
Color tone**	somewhat good	good	good
Color eveness**	sub- stantially none	good	sub- stantially none
Pass-to-back**	Yes	sub- stantially none	none
Edge sharpness*	good	good	somewhat good
<u>Overall evaluation</u>	good	good	good

20

25

1 Table 4 (continued)

<u>Example No.</u>	<u>11</u>	<u>12</u>	<u>13</u>
<u>Ink</u>	<u>Ink B</u>	<u>Ink B</u>	<u>Ink B</u>
<u>Cloth</u>	silk 100% habutae	silk 100% habutae	silk 100% habutae
<u>Ink Acceptor</u>	Prep. Ex. 4C	Prep. Ex. 5C	Prep. Ex. 6C
Thickness of acceptor (μm) *	1	18	25
Color Density**	good	good	somewhat good
Color tone**	good	good	good
Color eveness**	good	good	sub- stantially none
Pass-to-back**	sub- stantially none	sub- stantially none	sub- stantially none
Edge sharpness**	good	good	good
<u>Overall evaluation</u>	good	good	good

* Thickness of acceptor was determined by measurement according to the following formula:

20
$$\frac{[(\text{Thickness of 10 cloth sheets with the acceptor}) - (\text{thickness of cloth sheets without the acceptor})]}{20}$$

The measurement was made by a new model micro-thickness meter, Type PBM (made by Toyo Seiki K.K., Japan)

25 ** Each judgement was made from all-over print (about $2 \times 2 \text{ cm}^2$) and line print (about 1 mm wide and about 20 cm long) made on the cloth by a printer.

CLAIMS

1. A method of printing using an aqueous jet-ink containing a dye, the method comprising the steps of:
5 applying to a cloth or its constituent fibres a film 0.5 to 30 μ m thick of an ink acceptor comprising a water-soluble polymer or hydrophilic polymer capable of rapidly absorbing the aqueous jet-ink,
 depositing the aqueous jet-ink on the cloth by
10 ink-jet printing, and
 removing the ink acceptor after the dye is fixed on the cloth.
2. A method according to claim 1, wherein the
15 hydrophilic polymer is a natural or synthetic polymer.
3. A method according to claim 1 or claim 2, wherein the water soluble polymer or hydrophilic polymer is the main component of the ink acceptor.
20
4. A method according to any preceding claim, wherein the dye is a water-soluble dye.
5. A method according to any of claims 1 to 3,
25 wherein the dye is a disperse dye.



6. A method according to any preceding claim, wherein the aqueous jet-ink contains the dye at a concentration of 0.1 to 15% by weight.

5 7. A method according to any preceding claim, wherein the aqueous jet-ink contains water and a water-soluble organic solvent.

10 8. A method according to any preceding claim, wherein the cloth comprises synthetic fibres or a mixture of synthetic and natural fibres as the major component.

15 9. A method according to any one of the preceding claims in which the ink acceptor is applied to the fibres of the cloth before the fibres are made up into the cloth.

20 10. A method of textile printing substantially as described herein with reference to any one of the Examples.

