combiPRINT PP7

CombiPrint-PP7 is a newly developed ‚broadband' thickener system for all kind of carpets and textile printing technologies. It has excellent print properties and in addition it has a number of major advantages in comparison to oil based thickeners.

The name CombiPrint comes from the combination of the following characteristics:

- **excellent print definition and penetration with best colour yield**
- **high performance and thickening properties**
- **easy clean and easy dry**
- **environmental friendly, non toxic and non hazardous**
- **extremely cost effective**
- **used for digital and screen printing**

In the following an overview of the advantages and characteristics of CombiPrint product family:

Characteristics:

- fluffy, loose white powder with about 170 - 240 kg/m3 piled density
- based on cross-linked carboxyl chemistry
- high efficient thickener which can swallow up to 1000 time by binding water
- very high viscosity drop during shear effects

Package and shipping:

- packed in PU bags which are inserted in cardboard boxes with 20 kg - easy for shipment , transportation and handling
- each palette contains 16-24 cardboard boxes with 20 kg each - 320-480 kg in total
- bags can be emptied completely - no settlement no waste of product
- boxes can be recycled - no need to be cleaned and returned
- no special papers for shipping required because the product is non hazardous
- storage and shipping temperature (-40°C - +50°C) has no influence on properties
- boxes can be stored for 24 month as long as an open bag is not exposed to humidity. Humidity can change specific weight and can build lumps and skin on the powder but it will not effect thickening properties

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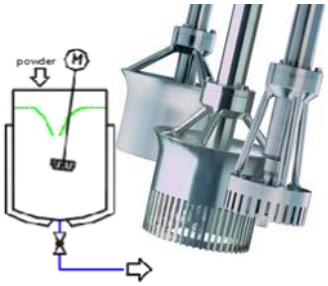
Preparation of Stock Thickener

Mixing and preparation of stock thickener:

- stock thickener is prepared by adding 10 g/litre of combiPRINT to de-mineralized water. If mixing equipment allows, up to 30 g/litre of PP7 can be added to form the stock paste.
- Quality of water is a very important issue. If water has a pH > 7 the stock paste will be too thick. In this case it must be adjusted using citric acid to a pH of about 6.5.
- It is also important that the water has no or very little electrolytes and minerals. Best would be water from reverse osmosis or at least it should be soft (de-mineralized) water.
- Batch operation is recommended by adding a full bag of combiPRINT-PP7 into 2000 litres of water to get a 10g/litre stock paste.
- a 10 g/l stock paste has a viscosity of about 100-700 cps (Haake VT02) and has a pH of about 2.8-3.2 - all depending on water.

Direct preparation in tank:



- Tank size should be about 3000 litre;
  a top cover with a opening or funnel is recommended to avoid dusting
  as mixer a jet stream type of mixer should be used
- mixing time depends on volume and type of mixer.
- after mixing it is important to give the stock paste a rest of min. 1 hour

Direct preparation in combination with SupraMix:

- Fill up amount of water and switch on the mixer or agitator with variable speed
- slowly insert the content of the bag and keep mixing till the powder is completely wetted out.
- pump the paste through an inline SupraMix into a holding tank.
- keep the paste without mixing for at least for 1 hour before use

If a customer has a SupraMix system it is easy to convert and use the SupraMix to homogenize the stock paste and pump it into a holding tank.

SupraMix-CP

for an efficient, dust-free and space saving operation Zimmer developed an in-line dosing and mixing unit to use CombiPrint products most efficient.

- The powder is sucked in by the strong negative pressure created by the reactor head. Immediately after contacting the liquid phase, the powders are instantly wetted and thoroughly dispersed. This process is actually completed before the powder is fully hydrated. Due to the extremely short time shear forces are applied, the process is a very gentle one. A single pass operation ensures that even when processing extremely shear-sensitive thickeners, the highest viscosities is achieved.

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Dye Preparation in General

Dyestuff compatibility:

- COMBIPRINT is compatible with all dyes used for carpet printing
- **Nylon and wool:** Acid, pre-met and reactive dyes
- **Acrylic and cationic Polyester:** Cationic dyes
- **Polyester:** Disperse dyes
- CombiPrint works best within a pH range of 3.5 - 8,5
- normally no additional chemicals like penetration agents, foaming agent, antifoam, acid donors, … are needed. This makes the process and recipe simple and low cost.

Dye preparation:

- For stock paste and dye preparation de-mineralized water should be used. This is to safe thickener and to avoid any flocculation caused by electrolytes and minerals.
- The amount of stock paste depends on the type of dye, the amount of dyestuff and the pH.
  For light colours typically about 100g of stock paste (= 1 g of CombiPrint) is used.
  For dark shades about 300-400 g of stock paste (= 3-4 g of CombiPrint) is used.

1. dissolve the dye according to the recommendation of dye supplier
2. add dissolved dyestuff to water
3. add stock thickener and stir the solution
4. Add a solution of caustic soda to adjust the pH and to bring up viscosity. Adjustment of viscosity and pH of the dye should be at the end of formulation. This makes it easy to mix in dye. (Exception is with cationic dyes - see section for acrylic printing).
5. fill up to final level with water

- In case viscosity is too high either citric acid could be added (this will also reduce the pH slightly but reduce viscosity sharply) or a solution of NaCl (salt) will bring down the viscosity.

Shelf life of the dye paste:

- because there is no organic material in the thickener the shelf live is very long (month)
- no need to add any preservatives - no smell after weeks
- no contamination with bacteria and no moulding (there is no food for them)
- no change in viscosity over a long time
- no change of shade of dye
- stock thickener and unused dye can be stored for weeks and can be mixed with other left over's into a new shade

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Dye Preparation for Polyamide (PA) Printing

- Polyamide (Nylon) normally requires acid- or 1:2 pre-met dyes or some selected reactive dyes
- The pH is in the range of 5.5 - 6.5.
  For some very heavy colours (i.e. black next to white) it might be an advantage to lower the pH to about 5. But this depends very much on carpet construction and type of polyamide.
- Lower pH is reducing fixation time but increases thickener consumption and cost
- Typical fixation time for PA6 is in the range of 3 - 4 minutes in saturated steam
- Typical fixation time for PA6.6 is in the range of 4-6 minutes in saturated steam
- If pH is too low it might be that the dye has no time for migration - in this case prints could be streaky and frosty.
- In case pH is too high and steam time is not sufficient not all dye will be fixed.

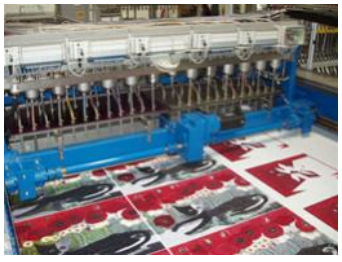



Typical amounts mixing a dye for nylon printing with ChromoJET

The actual amount depends on type of dyestuff and its content of salts and other electrolytes

1. Water 1 (soft water)	2. Acid or metal-complex Dye	3. Stock-paste of COMBIPRINT - 10g/litre	4. 1% solution of pure caustic soda (10g/litre)	5. Water 2 fill up to 1000 g	ph 6-6.4 viscosity of 450 cp (Haake VT02)
700 g	0,1 g/kg	125 g	32 g	x	
700 g	0,2 g/kg	140 g	40 g	x	
700 g	0,5 g/kg	170 g	50 g	x	
700 g	1 g/kg	200 g	66 g	x	
500 g	2 g/kg	280 g	100 g	x	

chromoJET



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Dye Preparation for Wool (WO) Printing

- Wool normally requires acid, pre-met or reactive dyes.
- The pH is in the range of 3.5 - 4.5 is recommended for heavy colours.
  Light shades can use a pH in the range of 4.5-5.5
- Lower pH is lowering fixation time.
- pH should not be lower than 3.5 otherwise the structure of wool can be damaged
- Typical fixation time for WO is in the range of 5 - 8 minutes
- If pH is too low it might be that the dye has no time for migration - in this case prints could be streaky and frosty.

Typical amounts mixing a dye for wool printing with ChromoJET

The actual amount depends on type of dyestuff and its content of salts and other electro-

1. Water 1 (soft water)	**2.** Dye (acid dye)	**3.** Stock-paste of COMBIPRINT - 10g/litre	**4.** 1% solution of caustic soda (10g/litre)	**5.** Water 2 fill up to 1000 g	pH 4 viscosity of 250 cp (Haake VT02)
700 g	0,1 g/kg	125 g	32 g	x	
700 g	0,2 g/kg	140 g	40 g	x	
700 g	0,5 g/kg	170 g	50 g	x	
700 g	1 g/kg	200 g	66 g	x	
500 g	2 g/kg	280 g	100 g	x	

The thickener gives a pere-fect penetration and sharp prints on difficult substrates like wool.

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Dye Preparation for Acrylic (PAC) Printing

- Acrylic requires cationic (basic) dyes.
- A pH is in the range of 4.5 - 6.5 is recommended. Please take notice of the recommendation of dyestuff supplier!
- Lower pH is lowering fixation time.
- Typical fixation time for PAN is in the range of 5 - 8 minutes only
- In case pH is too high and steam time is not sufficient not all dye will be fixed in time.
- The viscosity depends on type of application:
  ChromoJET printing 200 - 500 cps (Haake VT02)
  Screen printing 500 - 1000 cps (Haake VT02)

Perfect penetration and brilliant colours can be achieved

- <u>Process of acrylic printing:</u>
  > Printing (ChromoJET or flat screen printing)
  > Steaming of about 5 - 8 minutes at 102°C
  > washing (rinsing > vacuum > rinsing > vacuum)
  > Drying

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Dye Preparation for Polyester (PES) Printing

- **For dye preparation don't use any dispersing and fixation agent like Avolan IW!**
- Disperse dyes needs at least about 160°C to penetrate the Polyester fibre. This temperature can only be reached if the material is completely dry. As long as there is any water in the fabric or carpet the temperature will not go above 100°C. For this reason an easy drying is essential!

Typical process for printing on PES pile material

1. > Printing with a pH of about 4.5 - 6 using disperse dyes
2. > Drying - here CombiPRINT has a major advantage because it has no oil and releases water much easier and dries much faster without oily residues.
3. > Hot air -or overheated steam fixation with about 170°C and about 3-7 minutes
4. > Reduction clearing (washing with pH 10 and 70°C >
   > Rinsing with warm water
   > Neutralisation with a pH of about 6
5. > Drying

For some products with low demand in rub fastness the washing process and second drying process can be skipped.

Typical products:
nonwoven needle punch floor covering; polyester mink blankets; polyester loop pile carpet

PP7 is the perfect thickener for blanket printing . Easy drying and easy washing!

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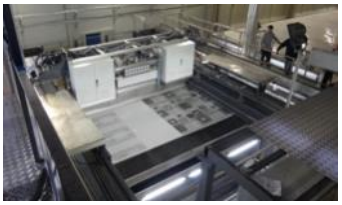
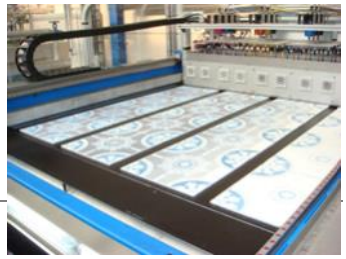
ChromoJET printing

ChromoJET Printing:

chromoJET

- higher viscosity can be used due to the high viscosity drop under shear stress (when the dye comes out of the jet and during its penetrates into the pile).
- typical viscosity (Haake VT02) used for PA (Nylon) carpet:
  loop pile with 250 - 300 g/m2 450 cps
  velour type cut pile with 400 -600 g/m2 350 cps
  heat set cut pile with 500 - 1000 g/m 300 cps
  heat-set cut pile with 1000 - 1500 g/m 250 cps
- no blockage of filter by ‚fish eyes'; practical size is much smaller than the smallest opening of filters
- can be used for 16, 25 and 76 dpi ChromoJET printing systems
- no frosting and excellent colour yield
- no dripping and splashing due to high viscosity at low shear stress
- better penetration - due to viscosity break down under shear stress
- faster and better fixation - because here is no oil which blocks the fibre
- wider range of pressure possible - related to viscosity reduction under shear stress
- no contamination of the system by oil/thickener sludge
- system and jets can be washed much faster and with less water
- **no chlorine bleach cleaning or detergent cleaning needed**






ChromoJET Print Line

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Steaming, washing drying of printed carpet

Steaming:

- the dye-paste is very thermo stable (almost no change of viscosity) during the steam process and therefore bleeding is avoided
- CombiPrint works well at low pH which reduces steam time and higher production can be achieved

Washing:

- because there is no oil and a very little of solid content of COMBIPRINT it is very easy to wash out.
- For the washing process demineralised water is strongly recommended to avoid that the thickener is flocked out in separation tanks and pumps

Drying:

- using CombiPrint thickener it is much easier to dry . The reason behind is that there is no oil which can stick onto the fibre and which is keeping the water encapsulated. Especially drying of backed carpet, mats and carpet tiles is easy and a lot of energy can be saved
- When printing Polyester with direct drying after printing the effect is tremendous because no fume, much faster drying time and almost no residues in the dried non-woven carpet. Drying time can cut up to 50% in comparison when using oil based thickeners.
- The picture on the right side shows a sample printed with oil based thickeners and with combiprint-PP7. The result is that the oil based thickener is not dry and the powder based section completely dry.

Drying test using oil based thickener and PP7 (right stripe)

Colour fastness:

- It has been shown that the colour fastness is at least as good as using oil based thickeners but in general it is up to 1 note higher

Soiling:

- unwashed oil and emulsifiers and left over thickener is attracting dust and soil. Due to the absence of any oil the carpet has a considerable lower tendency for soiling.

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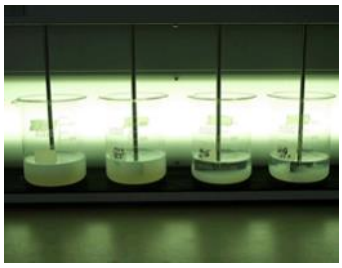
Enviroment and Waste Water

Waste water:

- The CombiPrint base chemistry is well established in pharmaceutical and cosmetics industry. Most of lotions, creams, diapers, emulsions and a lot of oral taken medicines are based on the same chemistry. The products are environmental friendly, non toxic and have no negative effect on bacteria in waste water treatment plants.

- The total oxygen demand COD is about 1100 mg/g and about 50% lower in comparison to oil based thickeners.
  Under the consideration that required amount is at least half in comparison the resulting COD demand is about 25% only.
- If needed it is easy to flock out the thickener from waste water using aluminium-chloride, aluminium-sulphate, iron(III)-chloride, calcium-oxide, …
  As higher the concentration of thickener in water - as easier the flocculation process. This means that thickener removed right after the steamer (before diluted with water) is easier to flock.
  A 0,25% solution of aluminium-chloride ($AlCl_2$) can be used to flock and filter up to 90% of PP7!!



- The sediments of the flocked colloids can be put in bags and dried or can go into a filter press and disposed or burned as non hazardous material

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Cost and support

Cost:

- the direct cost (thickener and chemicals) of printing is about 10 - 20% lower in comparison of using oil based thickeners.
- If the total cost is evaluated than the saving is much more by using CombiPrint products in comparison by using oil based thickeners (shipping, handling, cleaning of the system and tanks, waste water, drying energy, shelf life, …..)

Support:

- Zimmer, Chematron Inc. and SeattleChem L.L.C. can give advice and support related to printing and coating process development using COMBIPRINT powder thickener.
- At Zimmer in Kufstein, Austria number of equipment is available for testing and product development:
- ChromoJET carpet printing with 25, 50 and 76 dpi
- Colaris ink jet printing for flat fabrics, terry products, technical textiles,
- Colaris-NF ink jet printer for narrow fabrics
- GMA coating for precise application of pre-coats

Zimmer‘s team

Andre Penkert - ‚The Master‘

Martina -our specialist for designs, rips and colours

Pattrick - textile engineer and the master of Colaris

Annemarie - the ChromoJET sample printer is her tool

Timea - textile engineer and specialist for pre coating applications

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