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AEROSOLS – AN OPPORTUNITY FOR NANOTECHNOLOGY – SURFACETREATMENT; ALSO ON A LARGE SCALE*

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Abstract. A process for the production of nano-coatings is available for numerous application cases by using aerosols. The application to the adhesion improvement in inks, varnishes and adhesives particularly is of a great future potential. The technique, some examples of large scale productions and further specific applications will be shown.

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1. INTRODUCTION / PROCESS DEFINITIONS

Unlike the usual coating technologies like rollers sprays, plunge passes the possibility to put layers into effect with aerosols in the nanometer area (Figs. 1 and 2). Normally processes like vapor depositions are under vacuum conditions and it is possible to reach layer thickness of nanometer areas. An alternative method under normal conditions is the controlled usage of aerosols [1,2].

The parameters during application of aerosol drops are shown in the Fig 2. After evaporation of solvents, coatings with a thickness of less than 200 nm are left. To this liquids, water based predominantly, are sprayed by means of nozzle technology (Fig.3) to smallest drop (Ø < 1 mm). Also solvent based systems are in the application, however, presuppose a high security system regarding explosion protection. The produced droplet current is adjusted specifically by means of a control in the air-/ liquid relationship (Figs. 4 and 5).

The application of the floating droplets is carried out via three parameters in the process:

a) by condensation about a temperature difference between aerosol- and surface-temperature;
b) by electrical charging in a high electric field (Fig. 6) and
c) by gravitation.

These parameters are put into combination one by one and also depending on application need a high constancy of the variables. After the evaporation of water/solvents, solid layer thickness still remains in the nanometer area.

2. SOME EFFECTS

By lay-out of chemicals (Fig. 7) caused this one numerous effects [3,4] can be produced specifically, like:

· Bond strength;
· Antistatic behaviour;
· Attitude of the mate degree of a surface;
· Surface tension with long time effect;
· Catalysts e.g. adhesive tempering, *etc.*

(see Figs.8,9,10, and 11)

Fig.8 shows an example for better adhesion of UV-lacquers [5-8]. In this case tin plated steel is treated with corona and aerosols, based on acrylic acid with photoinitiators. A further example is the electrical behavior of a PET-film by aerosol treatment with antistatic chemicals. A change of the surface resistance is the effect. Also the behavior of

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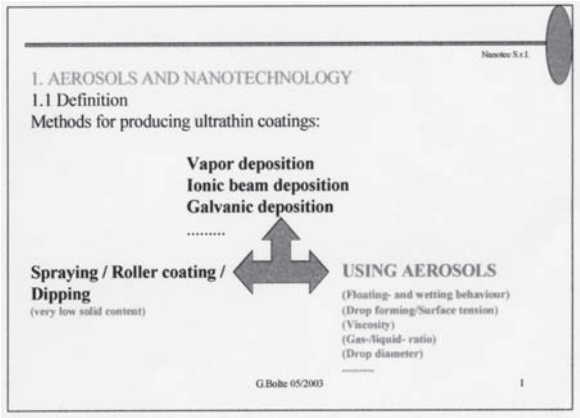

Fig. 1. Possibilities for nanocoating processes.

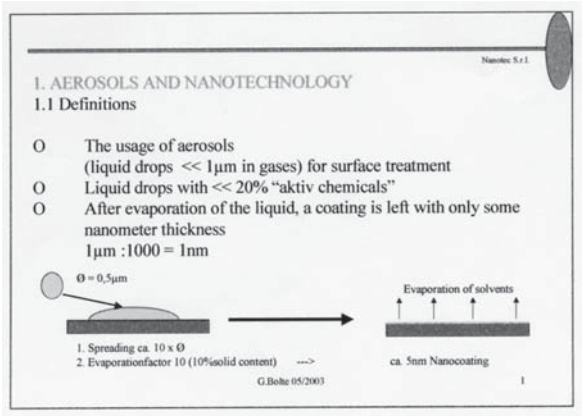

Fig. 2. Some definitions of aerosol-coating and the result of nanocoated surface.

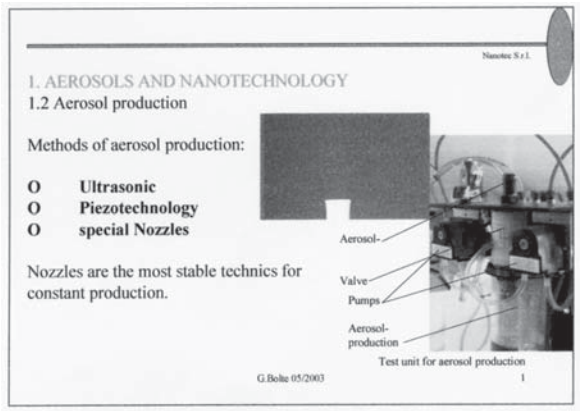

Fig. 3. Example of an aerosol-producing system during laboratory test.

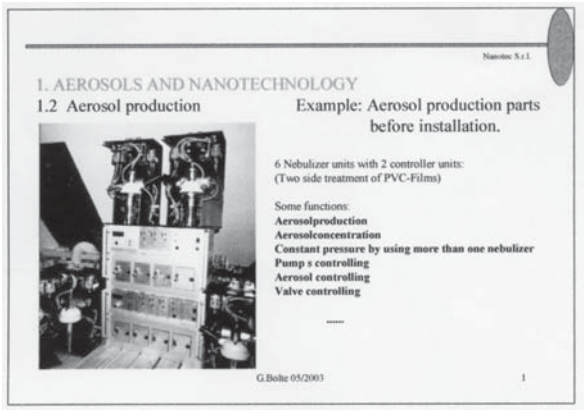

Fig. 4. A complete aerosol producing system including the controller unit just before installation in a both side PVC-film treatment(working width: ca. 2.300 mm/production speed ca. 70-100 m/min).

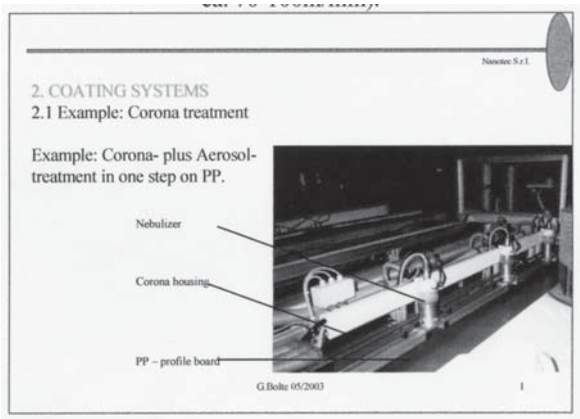

Fig. 5. An example of a PP- profile board treatment on both sides (surface-tension) (working width ca. 2.700 mm/ speed: ca. 1-10 m/min).

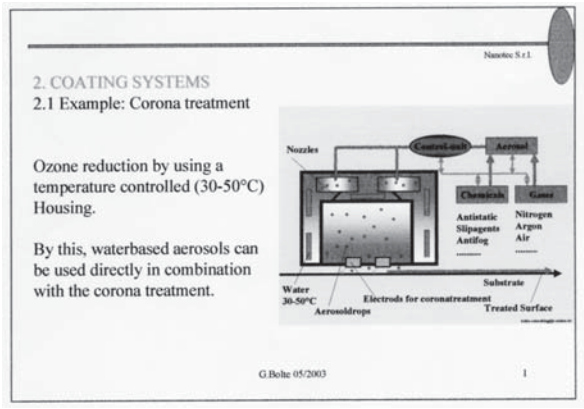

Fig.6. Principle of the aerosol treatment under an electrical field (corona) and a higher temperature of the aerosol drops than the substrate temperature (condensation effects).

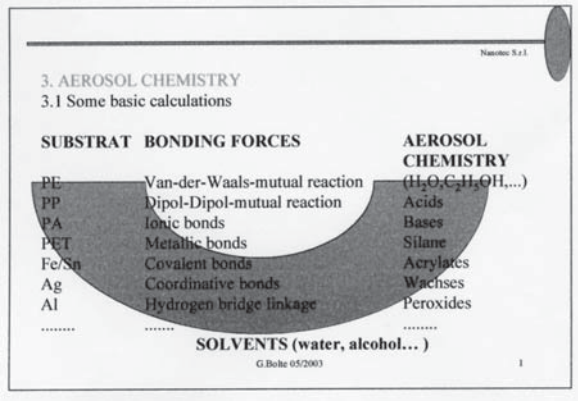

Fig. 7. Important correlations have to be considered by choce of different substrates and aerosol-liquids.

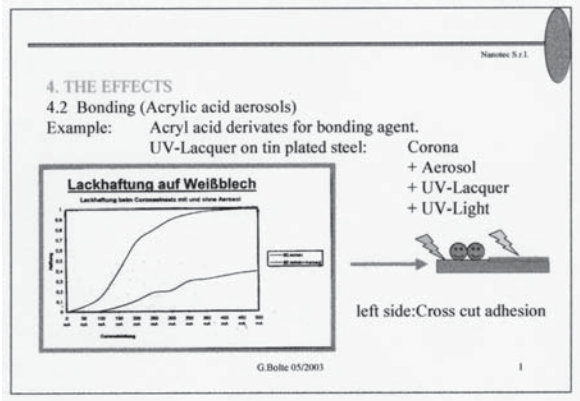

Fig.8. Example: Better UV-coating-adhesion on tin plated steal by using corona treatment and aerosols.

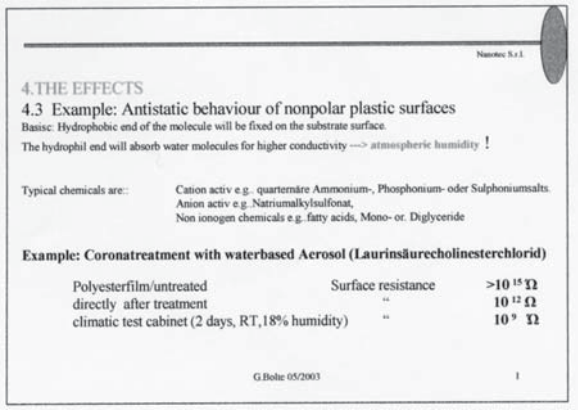

Fig. 9. Example: different electrical surface resistance by using antistatic aerosols.

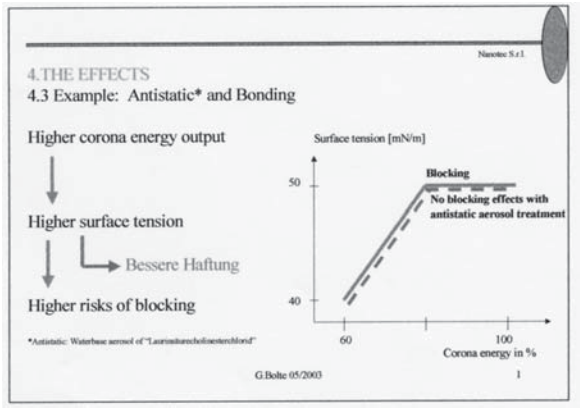

Fig. 10. Example of reducing blocking behavior of corona treated plastic films by using aerosols.

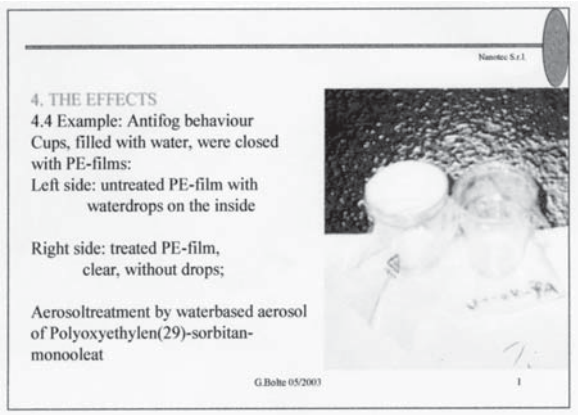

Fig.11. Example ofAntifog-behaviour of a PE-film. Left: water drops on the inside surface; right: no water drops are visible. Result: transparency.

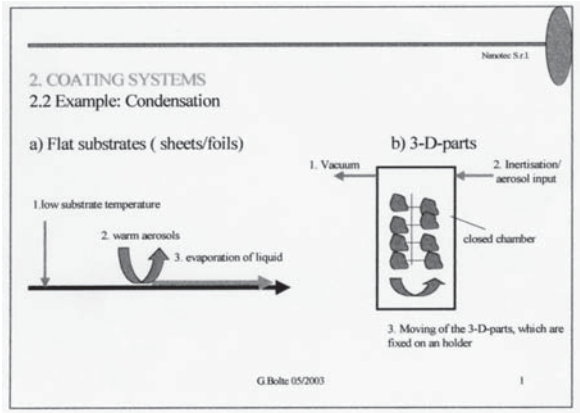

Fig. 12. Coating principles of flat material and 3-D parts.

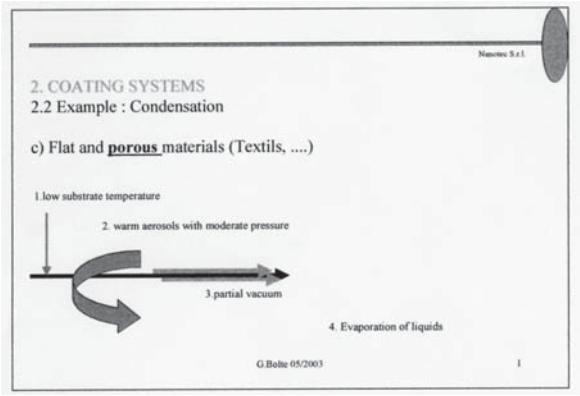

Fig 13. Coating principles of textiles.

plastic sheets (PP) can be changed by antistatic chemicals after corona treatment. They don't stick together even with a high surface tension.

The application pallet is extremely big due to the chemical variability. However, this presupposes a precise adaptation to the predefined conditions, like

· process control;
· speed.

As substrata both films/foils and 3-D parts come to use (Figs.12 and 13).

3. CONCLUSION

A process for the production of nano-coatings is available for numerous application cases. The application to the adhesion improvement for inks, varnishes and adhesives particularly is a great future potential. Important is however the attention of the most various basic conditions and the adaptation to the given requests.

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