Physics and application of electric infrared emitters

Drying of hydrophilic substrates and aqueous dispersion on their surface

Drying paper and its coatings are the most energy-intensive process in paper production. Drying takes place either by conduction, convection or radiation. The latter is the most expensive of the three energies, but under certain boundary conditions it is the energy of choice, especially if you want to dry goods that are moist on the surface, so that conduction - drying on a drying cylinder - is ruled out. We are focusing here on radiation. This can be easily decarbonized, and efficiency can be increased compared to current application scenarios. Some facts about this are hardly known, but they have a significant influence on the quality of the finished paper and its raw material costs.

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We shed light on some of the facts that are not known in detail to show papermakers the various options for optimizing their paper production. When drying coatings - especially functional coatings - drying control is crucial. However, temperature control in md is not expedient, especially because only the temperature of the surface can be recorded, not that of the initial sedimentation layer. However, temperature control in the z-direction is relevant.

When drying, it must always be borne in mind that over two thirds of the energy used to produce paper is used to dry the paper and the coating. Radiation is the most expensive form of energy, which is why the papermaker must be aware of how to optimize its use. The radiation used in the paper industry is infrared radiation, the wavelength of which is adjacent to visible light and spreads over a broad wavelength spectrum. Radiation of different wavelengths also has different effects on drying. Many of these facts also apply to the drying, profiling and preheating of substrates. We present these physical relationships in this article.

1 Drying

Drying in the paper industry is both simple and very difficult. The solvent of choice is water. We do not use other solvents in paper production, at most in subsequent steps such as printing. Water differs from many other solvents because it is bound to the material to be dried. This hydrogen bond towards the fibers as well as towards other water molecules must be overcome in addition to evaporation.

We must therefore concentrate on the interaction between water molecules and fibers or coating color components. We achieve this by stimulating hydrogen bonding and hydroxyl groups.

We achieve the excitation via the energy input. This must be large enough to separate water molecules from each other and separate them from the hydroxyl groups. However, drying is only complete when we have vaporized the water, i.e. moved it out of the material to be dried. We also must consider where the water has to move in order to minimize the amount of energy required. Drying is therefore always a two-stage process - and the energy input is largely responsible for how and where the water leaves the dry material. Here we should work with physics, not against it.