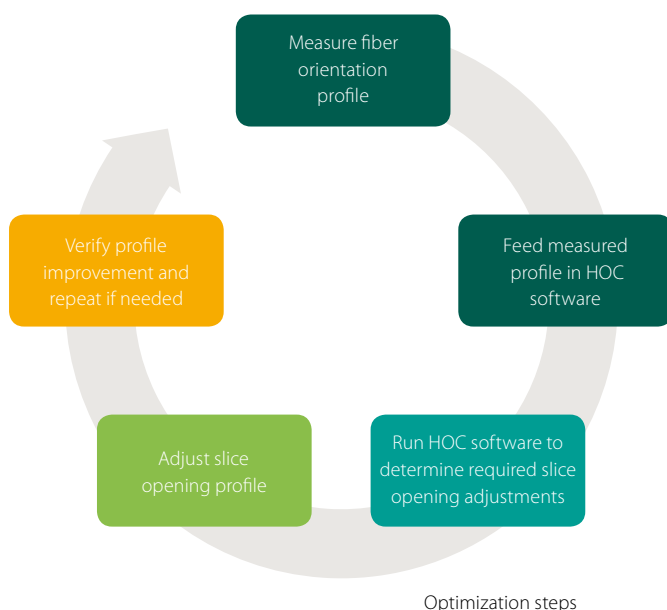


**TEXT** Mika Tammenoja

The sheet's fiber orientation plays a significant role both in terms of paper quality and machine runnability. A good fiber orientation profile will reduce the sheet's sensitivity to disturbances and its break propensity. Poor fiber orientation related quality problems may include the curling of paper or board, slack end-cut customer rolls and register problems in printing. A poor profile may also cause the sheet to fold over at the dryer section or in coating.

## Better quality and runnability through fiber orientation optimization

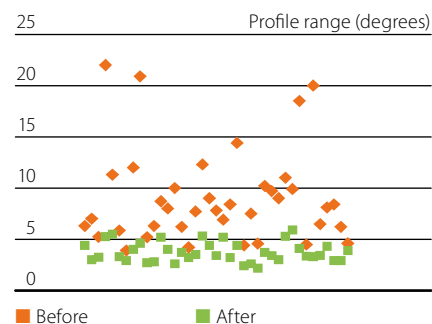


Fiber orientation angle deviations are caused by cross-directional flows inside the headbox or at the forming section. The edges of the sheet shrink more than the middle at the dryer section, whereby more stock is deposited at the edges. The basis weight profile is corrected by adjusting the headbox to provide less stock for the sheet edges. Dilution control equipped headboxes can adjust both the basis weight profile and fiber orientation profile independent of one another. Slice lip control equipped headboxes cannot fully do this as the basis weight profile adjustment required by the sheet's shrinkage profile is accomplished by closing the edge areas of the slice opening, which causes cross-directional flows inside the headbox and erodes the sheet's fiber orientation profile. Fiber orientation

profile adjustment through slice lip control may involve a compromise in relation to the sheet's basis weight profile. The fiber orientation profile produced by a slice lip control equipped headbox, particularly the sheet's edge areas, can be improved by means of headbox edge flows.

It is important for fiber orientation profile control that the headbox and forming section are in good mechanical condition in order to prevent any disturbing cross-directional flows during sheet formation. The straightness of the apron, slice lip wear and nicks, and headbox and forming section alignment errors and dirt buildup may lead to fiber orientation profile deviations. The proper operation of the apron heating system is also a prerequisite for good orientation profile control.

Improvement of fiber orientation by optimization



**Average improvement in** optimized fiber orientation angle profile.

### HOC software ensures precise angle profile control

The sheet's fiber orientation angle profile can be adjusted very straight by simulating the headbox flow field and setting the slice opening manually as indicated by the simulation results. Headbox Optimization Control (HOC) software is used for this purpose, which facilitates the precise and quick optimization of the fiber orientation profile. The simulation program is based on a combination of computer-assisted flow analysis and numerical optimization. Headbox flow simulation and slice profile adjustments help to produce a slice opening profile that provides an optimally straight fiber orientation angle profile.

The HOC software has already been used with success on more than fifty optimiza-

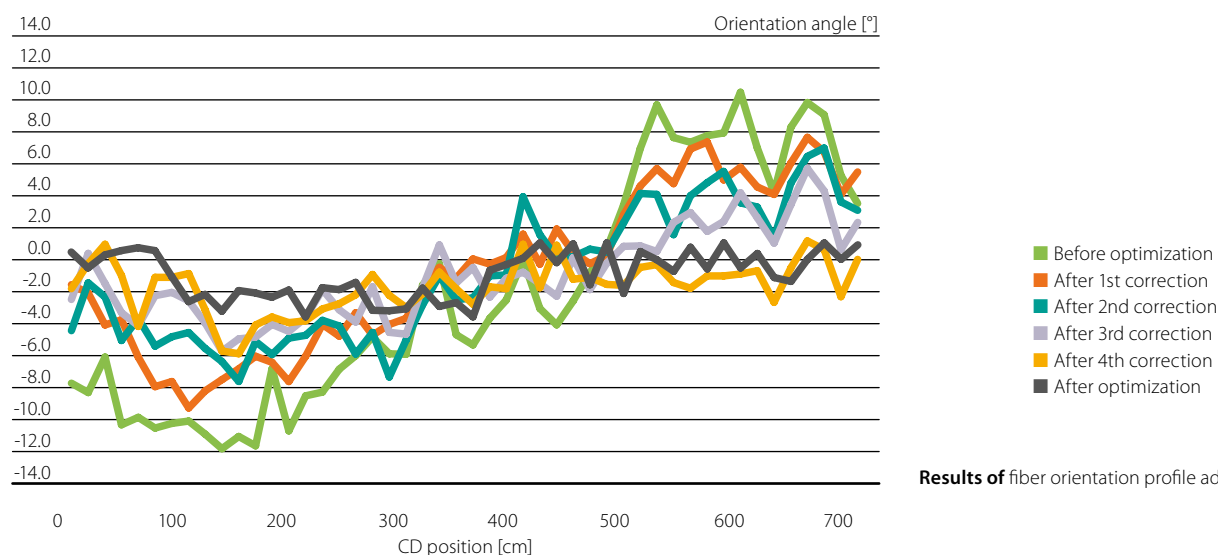
tion jobs. The average fiber orientation angle profile has been brought within less than  $\pm 2$  degrees, whereby no orientation related quality or runnability problems should exist even with the most demanding grades. Some of the cases have involved the fixing of a broad S shape, while others have called for the local correction of the largest angle gradients that have caused the sheet to fold over at the initial dewatering. Both have yielded excellent results. Other important factors affecting the fiber orientation profile in addition to the slice opening profile include the jet/wire ratio, headbox edge flows, headbox balance, such forming section components as the top forming unit and trim squirts, and the general mechanical condition of the headbox and forming section. These also need to be taken into

consideration in fiber orientation profile optimization.

#### Fiber orientation profile adjustment advisable right after headbox maintenance

Optimization helps to make full use of the technical capabilities of a dilution control equipped headbox in terms of both good basis weight and fiber orientation profiles. Some customers have already recognized this and want to ensure good fiber orientation profiles after headbox maintenance (apron reconditioning, slice lip replacement). Optimization can also be carried out on a slice lip control equipped headbox. However, a slice lip control equipped headbox involves a compromise between a good basis weight and fiber

orientation profile. Even if a machine lacks any clear fiber orientation related runnability problems and customer complaints are infrequent, a fine-tuned orientation profile will boost the machine's runnability further while also reducing the range of quality variations. This will furthermore provide a good basis for minimizing energy and material costs. □



Results of fiber orientation profile adjustments.