NANOPARTICLE PROSPECTS & PERSPECTIVES

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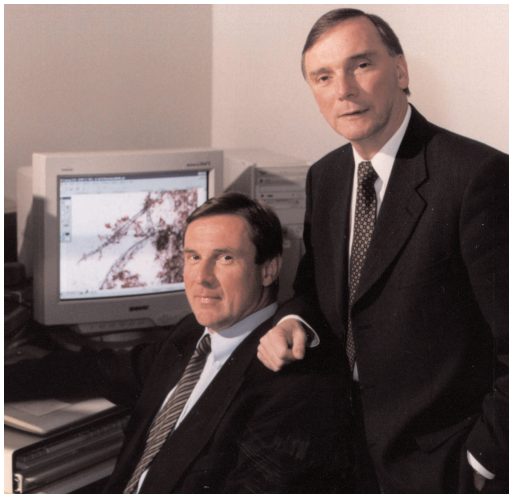
WET END CHEMICALS HAVE EVOLVED INTO HIGH PERFORMANCE PAPERMAKING SYSTEMS

EKA CHEMICALS, AKZO NOBEL, INTRODUCED SILICA MICROparticle retention/drainage systems to papermaking 20 years ago. Designed to allow higher filler content in place of more expensive fiber, the original product has developed into an interactive papermaking tool for quality, productivity, and environmental gains. New and improved silica nanoparticle systems are helping papermakers across a wide range of grades. From a single mill in Sweden in 1980, Eka Chemical's silica microparticle systems are now used on over 340 paper machines worldwide. In this interview, Byron Smith, CEO, and Lennart Nilsson, VP of Eka Chemicals, Akzo Nobel's Paper Chemicals Division, comment on the evolution of papemaking chemical technology.

Q: It's been said that performance chemistry—specifically micro/nanoparticle technology—has revolutionized the paper industry over the past 20 years. Can you elaborate on the validity of this claim?

Smith: The original microparticle (now nanoparticle) systems have indeed revolutionized the paper industry. In 1980 chemicals could never have been expected to aid in developing new grades, changing paper properties, or impacting the reduction of fiber. Pre-microparticle technology, a retention chemical was a retention aid only—and nothing more. I don't think the customers saw a link with other chemical additives, or other paper properties and machine runnability. We now look at performance chemistry as a means of connecting chemical parameters of the wet end. We look at the effect of the output of a paper machine, and the quality of the product being produced. There is no doubt that micro and nanoparticle technology systems have achieved both ends. I have personally seen output up to 25% higher on certain grades. Paper formation and strength have improved measurably, as well.

Nilsson: Micro and nanoparticle technology started to take wet-end chemistry out of the dark ages. It was a breakthrough that started to make people think that we could do a great deal with "wet-end chemistry vs. machinery," the latter being the only way in the past. Over all, there has been a far greater technology focus on the wet end in past 15 years.



Lennart Nilsson, left, and Byron Smith

Q: How do machinery suppliers and chemicals suppliers work together to add value to papermaking?

Smith: Chemical suppliers and machinery people now work in closer harmony to achieve things for the customer. Eka's cooperation with machinery manufacturers has become an important element of our R&D and applications work. This is a step forward, because, historically, the chemical industry tended to follow new developments from the machinery manufacturers, and, therefore, tried to cope with new demands on the wet end of the paper machine.

The future will place more and more demands on chemical manufacturers because of the demands on paper products. New grades will demand a more serious look from the wet end chemistry perspective. With new or evolving grades in mind, it's likely that nanoparticle chemistry will have to be considered as part of any wet-end chemical package.

Flexibility is central to the nanoparticle story—the ability to maneuver paper properties in ways we couldn't dream of with pre-1980s polyacrylamides. In the old days of the 1970s and before, you got what you got. Today with nanoparticle flexibility, that being mainly "retention," you might dramatically improve papermaking. Once you understand your wet end system thoroughly, and you have nanoparticle technology in place, a simple touch of a pump can produce a bold result.

What I'm really saying is that if you have the know-how, application of high performance chemistry can be quite impressive. This doesn't mean that chemical suppliers can revolutionize every grade of paper, and do so on their own. The point is that experience and know-how are worth something, particularly when that know-how focuses around breakthrough chemical technology for papermakers.

Q: What about the advances through electronics at the wet end—like real time monitoring and control?

Smith: Not so long ago many wet ends of paper machines were black holes, and no one really knew what was going on, especially on a continuous basis. Soon after the original Compozil breakthrough, we decided to look into ways to better control the chemistry, and its impact on the process. Our objective from the start was to work with papermakers to figure out a way to understand chemical interactions on the paper machine and learn how to control them. Process equipment development-needed to move forward in order to maintain the wet end at optimum performance.

Smart molecules and smart applications with smart master systems all needed to develop. While major advances had been made in overall process control for papermaking, no system existed to eliminate the black hole dimension of the wet end. In our case, we invented Chemtronics real-time monitoring and control. This has made a considerable difference by providing continuous information about retention, stock consistencies, or other parameters to give the complete package. But we try to do more than gather info. The key to major improvement is what you do with it. We try to use the information to help with paper quality and product consistency, or to work with a particle paper property, like strength or formation.

Nilsson: Interpretation of chemistry requires considerable knowledge and open minds. Sometimes what appears to be a roadblock is really the door to the next level of performance. This is why we encourage teams of specialists to combine their skills with the wet end operators closest to a particular problem or opportunity.

Q: With the original Compozil™ patent coming to an end, what does that mean for your business? What does this mean for the paper industry?

Smith: One of our early Compozil patents comes to an end in 2001. As much as we have advanced over the past 20 years, you could say that our patent for a "Model T" is about to expire, while we are now focused on interstellar travel. I don't mean to belittle the original Compozil breakthrough. It's just that we have gone a long way since then—now to a 3rd generation family of microchemistry, which are actually "nanoparticle" systems. Our most recent patent will continue for another 15 years.

If a paper producer really wanted to buy the original silica microparticle system from a competitor or us they would be employing a somewhat dated system. The original Compozil, just like a black-and-white TV, was extraordinary in its day. But, like today's wide-screen HDTV with Dolby stereo that's Internet ready, why not go with the times? The good news for the papermaker is that the new generation of nanoparticle systems actually save more money than the original offering…in part because it can do more for a wider range of grades.

New nanoparticle systems are our most rapidly increasing business. You'll get a micro-retention and drainage system with the original Compozil, but not necessarily the best value through the highest performance.

Q: What does a papermaker get with the latest nanoparticle developments?

Smith: The newest systems provide flexibility for those pushing the wet end beyond traditional boundaries. We would have no business if papermakers didn't gain more value. In addition to silica nanoparticle technology, we deliver cationic polymers and anionic trash collectors to maximize results. We have also designed AKD, and ASA sizing, as well as surface sizing to work harmoniously with the silica sols.

Q: What is the most innovative change in high performance chemistry that you see on the horizon? How will it impact the next 20 years?

Smith: Compared to 20 years back, our baseline on understanding is so far ahead, it's hard to even think back of the old days of paper chemistry, focusing on one function at a time. Today's nanoparticle systems are interlinked with paper properties. We have taken a quantum leap to a totally different level of understanding. Smoother, crisper printing on faster printing presses. Liquid packaging containers that travel across the globe, boxes that cost shippers and corporations billions less in

transportation costs and postal fees because of lower basis weights: these are the accomplishments to which performance chemistry has contributed over the past 20 years. What's ahead will be further progress in these areas, and others, both for the end products, and in terms of mill production techniques, which will put heavier demand on chemicals.

Tomorrow's paper machines will combine with nanochemistry developments to produce vast potential for value for money and also with product development and uptime for customers, which means better products made cost effectively.

Q: What about single sourcing of chemicals for the wet end? Does this really work?

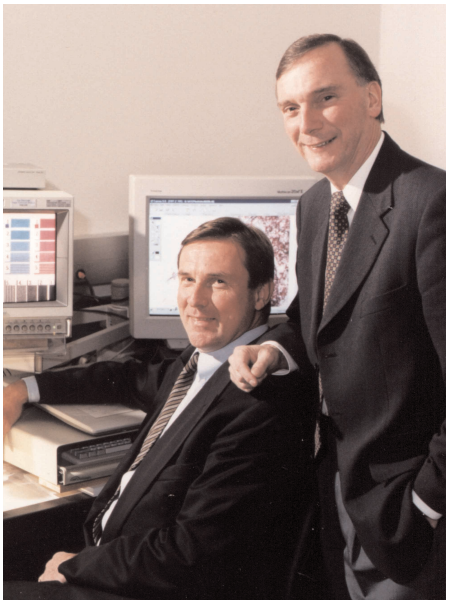
Smith: We see single-sourcing as a concept originating from the United States. There are some misconceptions in this area because the "pure" form of single-sourcing, that is, buying all chemicals from one supplier at many mills, is still the exception rather than the rule. What we do see is an overall trend to have more preferred suppliers and wet-end partners for high performance chemicals, especially like sizing agents and nanoparticle retention systems, where we have a leading position.

Nilsson: Single-sourcing or the preferred supplier idea for true performance chemicals can certainly work in the right circumstances, because it must go hand in hand with mutual trust and a sound technical relationship. This doesn't just happen—it takes time to develop. I remain convinced that this is good for a customer in the long term. To buy every and all chemicals from one supplier, from both a technical and cost effective standpoint, makes good business sense.

Q: How can suppliers bring more to the industry?

Smith: Generating trust and partnership with customers will always be the basis for our growth. It all comes back to a clear vision of what we are trying to provide, and remaining committed to innovation through R&D and applications know how. Training and education must be ongoing. Our approach is that we will never just walk in and say we can do this or that for you, just because that's what someone wants to hear.

If we have never been in that mill before, then we need to do our homework at the mill site and in our labs to get a good baseline feeling. It's nonsense if you haven't been there before. I'd throw a supplier out if they hadn't done their homework. First, before "promising" me the moon, you need people to provide a common sense program of where you are now, and where you can go, and stepwise ways to minimize risk. Don't lose paper even for 10 minutes. Changes should first be made gradually, with both sides knowing possible upsides and downsides. Steps that follow can be quite bold, based on mutual trust and the willingness to reach a new plateau.



I consider it a great compliment when customers ask us to help with issues that have nothing to do with wet-end chemistry.

Q: What about the customer's customer? How can you help them?

Smith: Historically, this is a sensitive issue. We don't ever want a customer to feel we would interfere with their relationship with their customer. But sometimes our knowledge can help. When appropriate, we'll confer on a problem at their customer, and even go with them on a visit, acting as a colleague.

Q: What's ahead for nanoparticle systems, a long future?

Smith: As long as paper producers are trying to improve quality, runnability, and develop new grades—with greater value and at lower costs—then there will always be a place for advanced chemistry, which helps provide the best balance of properties. An added bonus is heightened environmental performance. One thing is certain: Over the next 15 years, advances in nanoparticle chemistries will reach across nearly every grade of paper and board—and help papermakers be more profitable! **TJ**

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