Research in the Synthetic Rubber Industry, A Quality Producers Perspecitve[1]

Research · Development · Quality · ISO 9001 · KPI

Researchers in the rubber industry concentrate their work more and more on improving processes and quality or the modification of existing molecular structures. The pressures from the automotive industry and globalization are forcing everyone to optimize each and every process in order to reduce costs and keep a position amongst the technology leaders. Every aspect of a business is being evaluated, especially research. The traditional role of research & development in industry is changing – basic research is being outsourced to universities or institutes, not only those close to home. This leads to new questions; for example, how to handle Intellectual Property. R&D work is increasingly concentrated on customers projects using QM tools (ISO 9001) in order to avoid unnecessary experiments and accelerate "time-to-market". It is important for a company, which is committed to produce high quality products, to find the right balance between basic, long term research and quickly solving the customer's problems.

Forschung in der Synthesekautschuk- Industrie aus Sicht eines Qualitätsherstellers

Forschung · Entwicklung · Qualität · ISO 9001 · Kennzahlen

Forscher in der Kautschukindustrie konzentrieren sich auf die Verbesserung der Prozesse und der Qualität sowie die Modifizierung bestehender Polymere. Kostendruck insbesondere von Seiten der Automobilindustrie sowie neue Herausforderungen der Globalisierung zwingen dazu, jeden einzelnen Prozess hinsichtlich Kostenreduktion zu überprüfen. Dabei wird jeder Bereich auf den Prüfstand gestellt, besonders die Forschung.
Die traditionelle Rolle von Forschung und Entwicklung in der Kautschukindustrie wandelt sich, Grundlagenforschung wird zunehmend an Universitäten und Institute im In- und Ausland abgegeben. Der Schwerpunkt der eigenen F&E konzentriert sich auf Kundenprojekte, Qualitätsmanagement (QM) Systeme wie ISO 9001 helfen dabei, unnötige Versuche zu vermeiden und möglichst schnell das vom Kunden gewünschte Produkt herzustellen. Es ist von größter Bedeutung für eine Firma, die Qualitätsprodukte fertigt, den richtigen Kompromis zu finden zwischen langfristiger Forschung, die das Geschäft von morgen sichert, und kurzfristigen Projekten, um die Kundenwünsche schnell zu erfüllen.

About a century ago research into synthetic rubber begun; the target was to find a substitute for an important and precious raw material: Natural rubber (NR). NR can only be "produced" in certain parts of the world. Due to the increasing industrialization and developments in the mode of transport, the demand for rubber was rapidly expanding.
In 1909 the first patent for synthetic rubber (SR) was filed for a polymer based on 2,3-dimethyl butadiene. During the next decades, more milestones followed such as the discovery of polybutadiene (BR), styrene-butadiene copolymers (SBR) [1], acrylonitrile-butadiene copolymers (NBR) and polychloroprene (CR). The development of those new types of rubber was not based on coincidental findings in the laboratory but rather on arduous and systematic research. Industry committed considerable resources in terms of manpower and capital to the projects. The basic experiments with reaction times of several weeks (!) were not promising for industrial application. The decision was nevertheless made to continue. It should also not be forgotten that at that time the basic science of macromolecules were not well established, Staudingers approach of high molecular weight molecules were regarded as "grease chemistry", he was told "Drop the idea of large molecules, ...purify your rubber, then it will crystallize" [2].
During the Second World War the development of SR became of strategic importance. The American GRS program (Government Rubber Styrene) to produce SBR was the second best funded project; the best was the Manhattan project!
In the 50's and 60's new polymer families were discovered, such as EPDM, based on the findings of Ziegler and Natta, EVM, a copolymer of ethylene and vinyl acetate, ACM, and fluorine containing polymers. At this stage the focus of research was on the development of new polymers [3, 4].
The hype of new polymers slowly faded, the number of commercially available monomers was limited and so were the applications. Therefore, during the next phase, existing polymers were modified in order to optimize product properties, such as:

- Halogenation of butyl rubber to obtain bromobutyl and chlorobutyl rubber for tyre inner liners [5]
- Hydrogenation of NBR to obtain HNBR, a polymer which offers an excellent balance of high temperature, dynamic and oil resistant properties.
- Modification of Solution-SBR in order to improve rolling resistance, wet grip and abrasion resistance [6, 7]
- Development of rubber grades without highly aromatic extender oils

Research: Change of focus

Nowadays, the focus of research is changing in the rubber industry: The times of big central research labs, concentrating on basic research work, is over [8, 9]. Priority is now turning to the modification of products and the optimization of production processes in order to produce high quality products reproducibly under the safest and

[1] Presented at the ISE 2007, 11.th International Seminar on Elastomers, Freiburg, September 2007

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most environmental friendly conditions. Many rubbers are not regarded as specialties and thus companies are less willing to spend money on high risk research projects. Innovation is driven by the requirements of the market. Due to competition, and the demands of the capital stake holders "time-to-market" is the crucial factor! The pressures from the automotive industry and globalization are forcing everyone to optimize each and every process in order to reduce costs maintain a position amongst the technology leaders. Every aspect of a business is evaluated, especially research – is it essential or only "nice to have?".

The calculation of the benefit of R&D is complex and defining objective performance indicators is as difficult for research as it is for advertising. But a chemical company without advertising or research will not survive long! A well organized, focused research enables a company to offer, long term, not only high quality products but also those products the developing market requires. Only a deep, fundamental knowledge of the relationship between the structures of the rubber molecules and their resulting properties in the finished article results in the development of those products the market demands.

However, the pressure on costs leads to an increasing pressure to work more cost efficiently, e.g. with the implementation of Quality Management systems, such as ISO 9001, which was introduced in the rubber industry in the 90's [10, 11]. The big question is how to measure it? What are the best "Key Performance Indicators" for a good research process [12]? Depending on the structure of the company it may be

- the number of new products in the portfolio
- the turnover of new products related to the overall turnover
- the number of patents or reports
- the cost savings in the production process related to research projects

One way to keep a good level of research with limited resources is to outsource certain projects to universities and research institutes. Especially high risk projects on new ideas for basic research or laboratory screening can best be handled outside the company. This outsourcing not only has the benefit of saving cost (or headcount) but also offers other advantages: companies can demonstrate in academia, that rubber is an interesting field of work, future employees already familiar with rubber can be educated. Also programs from rubber associations, such as R&D projects from the DKG (Deutsche Kautschuk Gesellschaft) help to draw more students into the rubber community, where well-educated graduates are always needed!

The times where cooperations were only entered with universities nearby are over. In order to keep up with the globalization, cooperations with institutes in the rapidly developing markets such as India and China are not only interesting but worthwhile. In a global company it is important that for future employees the global talent pool is tapped. Additionally, in these developing economies many rubber manufacturers do not have their own development departments but rather, they also outsource their development work. Furthermore, even if the students don't become future employees they may well become future customers.

However, outsourcing research requires careful consideration of Intellectual Property so that not all projects may be suitable; e.g. those requiring detailed production process Know How.

In the past, each company had large testing facilities and pilot plant for internal use only. Here a change can also be seen: The facilities as well as the know-how are opened to other companies as a service. Lanxess as an example offers the Know-How of their rubber testing department [13, 14] in Leverkusen as well as their chemical pilot plant in Dormagen.

Product Development

The development work has also changed over the last decades. In the past new polymers were developed, which were presented to the market in order to find applications for them. Today, the work is market driven, the requirements for new applications means finding a solution for the customer's problem.

A good example is the development of Therban AT (Advanced Technology), in a close co-operation with customers HNBR grades with low viscosity were developed for new applications. The advantages are improved processing properities such as flow and mixing. This new technology won the DKG Product Award 2006.

In order to optimize the development work also new analytical methods are developed, such as a method to estimate the molecular weight and its distribution by Wrana and Kroll [15].

There is a strong tendency from the automotive industry to develop new models in shorter cycles. Due to time and cost restraints, more and more development work has to be done by the automotive supplier. Depending on the model, 50 to 90 % of the development is "outsourced" to the suppliers [16-18]. In order to match these requirements of quality and efficiency, it is essential to organise development projects efficiently. A good and pragmatic [19, 20] Quality Management system can support this approach. Using QM tools such as FMEA (Failure Mode and Effects Analysis), project plans with milestones and repeated customer contact ensures the desired product solution is attained in the shortest possible time.

Conclusions

Even a century after the discovery of synthetic rubber, there is a need for further research and development in order to optimize production processes and to really understand the products themselves. Due to the pressure of the market, it is important for a company, which is committed to produce high quality products, to find the right balance between

- basic, long term research and simply, quickly solving the customer's problems
- in-house research and external partners
- developing, globally, the best relationships with our present and future customers
- organized R&D processes (QM!) and creative space for new ideas

Lanxess committed itself to market driven R&D. Innovation is regarded as the transition of knowledge into business. The target is, that 80 % of the projects succeed in the market within a period of two years. This is only possible with a good innovation culture and a systematic exchange with science and customers.

Acknowledgements

The author would like to thank Lanxess Deutschland GmbH for the permission to publish this paper.

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References:

[1] H. Logemann, G. Pampus, *Kautschuk Gummi Kunststoffe* **23** (1970) 479.

[2] H. Morawetz, *Rubber Chemistry and Technology* **73** (2000) 405.

[3] F. M. McMillan, *The Chain Straighteners*, The MacMillan Press Ltd, London, 1979.

[4] W. Hofmann, "Kautschuk-Technologie", Gentner Verlag Stuttgart, 1980.
[5] A. J. M. Sumner, R. Engehausen, ACS Meeting, Orlando, September 1999.
[6] A. F. Halasa et. alt. , Deutsche Kautschuk Tagung (DKT), Nürnberg, July 2006.
[7] R. Engehausen, A. Rawlinson, J. Trimbach, *Kautschuk Gummi Kunststoffe* **54** (2001) 528.
[8] U. Koemm, GDCh presentation, University of Dortmund, May 2007.
[9] P. Herzog, B. Niedergassel, *Nachrichten aus der Chemie* **55** (2007) 531.
[10] R. Engehausen, *Kautsch., Gummi, Kunstst.* **60** (2007) 32
[11] R. Engehausen, Deutsche Kautschuk Tagung (DKT), Nürnberg, July 2006.
[12] H. -J. Graf, J. Ziegler, DKG Fachtagung, June 2007, Fulda.
[13] J. Wassen, C. Wrana *GAK*, **59** (2006) 152.
[14] For details: www.polymeranalytics.lanxess.com.
[15] C. Wrana, J. Kroll, ISE 2007, Freibung.
[16] R. Stenger, Kautschuk-Herbst Kolloquium 2004, Hannover.
[17] E. Helmig, *Qualität und Zuverlässigkeit* **50 (10)** (2005) 22.
[18] F. Dudenhöffer, *Qualität und Zuverlässigkeit* **50(10)** (2005) 19.
[19] J. Schiemann, DKG Fachtagung, Fulda, June 2007.
[20] T. Simon, Deutsche Kautschuk Tagung (DKT), Nürnberg, July 2006.