ABTO Software
Science Intensive Solutions Overview

Give us your most sophisticated task – we'll offer you our unique solution of your innovative idea.

Nowadays a lot of companies do not only require ordinary software development but also need to adapt it to specific production conditions and hardware. Such tasks often demand high analytic capabilities and deep scientific approach.

ABTO Software specialists combine strong knowledge of mathematics, in-depth R&D experience and enthusiasm to efficiently accomplish high-tech projects. We provide high-end analytical services for all types of companies and organizations, and solve tasks of different levels of complexity depending on the company's business area. Our customers can fully rely on our experts' creativity and responsible attitude to work.

We seamlessly execute tasks requiring high technical or mathematical skills due to our strong specialized education and scientific approach. The end products of such science intense projects are applications or set of "intelligent" applications helping to achieve customers' desired goals.

When we successfully accomplish a science intensive project for you, you will stand out for the quality in your activity sphere, considerably reduce your costs, receive an additional revenue source and definitely gain a lot of competitive advantages on the market.

R&D Solutions to Meet Your Business Challenges

ABTO Software provides highly efficient tools for rapid business growth and corporate vision achievement. Please, view a list of several cases we dealt with:

- Workflow and other important processes optimization to increase efficiency and/or cut on companies' expenses (warehousing, consumption estimation, logistics related problems, human resources management and workload issues).
- Analytical solutions vital to control sophisticated processes in healthcare, communications and networking, logistics, etc. including collecting, processing and analyzing large volumes of statistical data.
- Process simulation by making appropriate mathematical models and creating software in cases when it is too expensive/ complicated or even dangerous to conduct experiments for improving and innovating certain processes.
- Finance and investments often require prediction and tracking solutions, and we have extremely positive experience in this area as well.

R&D Software Development Serves Your Business Values

Research & Development helps companies foster innovation, remain competitive and as a result increase their revenue as well as obtain new knowledge, applicable to the company's business needs. ABTO Software perceives R&D services as the first milestone towards satisfaction of our most demanding customers' needs. We also understand that carrying out science intensive projects, both services and work performance, often requires extensive data collection, its analysis and usage of the most innovative technologies and tools.

A set of our science intensive software tools is efficiently utilized in quite varied industries worldwide, including:

- ✓ Healthcare
- ✓ Military & Police
- ✓ Chemical Industry
- ✓ Agriculture
- ✓ Manufacturing, Packaging
- ✓ Electronics & Nanoelectronics
- ✓ Construction.

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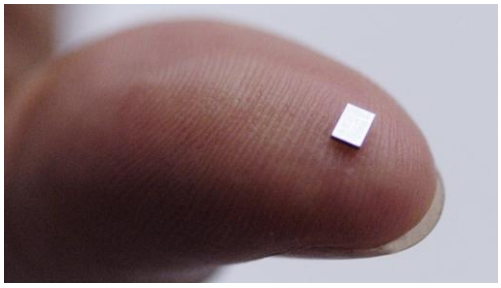
Professional Services in Science Intense Development

Science intensive expertise and innovative approach distinguish ABTO Software on the IT outsourcing market from the moment the company was set up.

Our services within science intensive development and R&D activities include mathematical modeling. This gives our customers, who need mathematical modeling in their technological processes, e.g. in mechanical and electrical engineering, technological chemistry industries, etc. a powerful tool for solving their industrial problems.

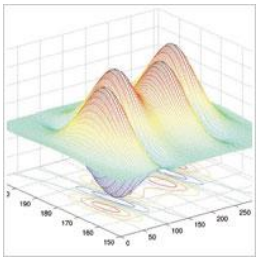
Our experience and theoretical knowledge in mathematical modeling and related fields can be roughly categorized as follows:



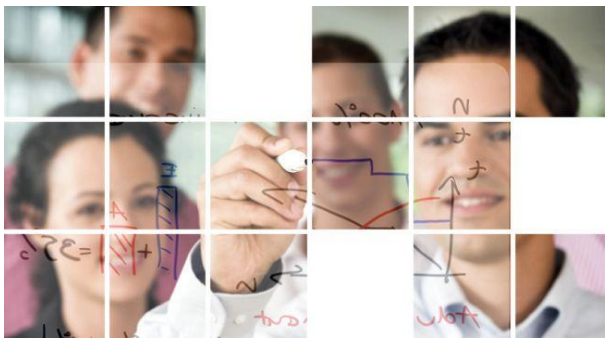
1. Numerical Analysis
2. Applied Analysis
3. Queuing & Simulation
4. Statistics
5. Applied Optimization
6. Electricity & Magnetism
7. Mathematical physics
8. Solid State Physics
9. Elasticity Theory
10. Membrane theory
11. String theory
12. Regression Analysis
13. Time Series Analysis
14. Signal Analysis
15. Acoustics
16. Hydraulics
17. Quantum theory
18. Statistical quality control
19. Neural networks
20. Image analysis
21. Molecular Biophysics
22. Chemistry
23. Design of experiments
24. Other

The complete cycle of mathematical modeling services offered by ABTO consists of the following stages:

- ✓ problem formulation
- ✓ constructing a mathematical model
- ✓ solving the mathematical problem (often numerically)
- ✓ creating software
- ✓ interpreting the results.



Hire a Creative World-Class Team of R&D Developers



Ukraine boasts a world-class technical education level inherited historically. ABTO Software's specialists' education perfectly fits to serve customers requiring implementation of specific scientific and hi-tech research projects. 92% of ABTO Software developers have higher education and 86% of them attained bachelor or master's degree in Applied Mathematics, Physics, Software Engineering and other related sciences.

Give a Trial to Our Science Intensive Approach to Your Project

We at ABTO Software are experienced in accomplishing sophisticated science intensive projects that requires specific scientific knowledge, creative approach and world-class education and considered to be nearly impossible to accomplish. These include mathematical modeling, security-based applications, voice and sound recognition software, etc. Please, take a look at the sample projects accomplished by our specialists below.

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User Identification Based on Foot Pressure Profile

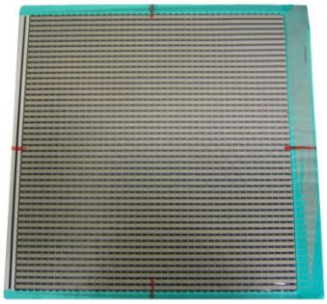
Industry: Healthcare, Military & Police

Customer: Philips Research Eindhoven - a global organization that helps Philips introduce meaningful innovations. It provides technology options for innovations in the area of health and well-being, targeted at both developed and emerging markets.

Country: The Netherlands

Description: Our customer developed Smart Floor- a device for positioning/tracking and identifying people, based on their foot pressure profile in standing position. The initial task for our team was to determine if it's possible to identify a person on the basis of his/her foot pressure profile and find out the most relevant identification criteria.

Picture 1. The Smart Floor mat

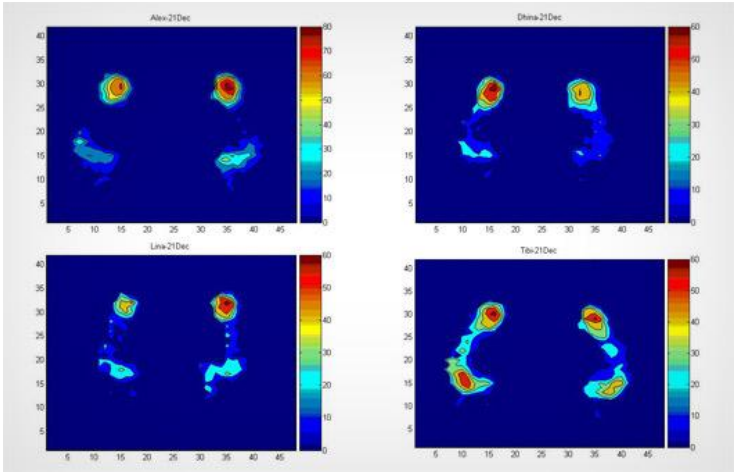


The following criteria were determined during our research:

- total pressure values
- ratio between the right and the left foot
- ratio between front and rear of the right foot
- ratio between front and rear of the left foot
- length of foot, foot surface area
- shape of pressure profile of the quadrants.

Experiments' results:

Picture 2. The contour plots of pressure profile of different individuals.



- We concluded that it's possible to identify a cooperative person on the basis of his/her foot pressure profile in standing position (barefoot people – 98% correct classification, in shoes - 82%).
- 10 identification criteria were researched. Total pressure value and the Foot surface were recognized as the most relevant criteria for the discrimination of persons in small groups (11 people).
- To determine identification criteria for larger groups of people the experiments with bigger number of participants must be conducted.
- 15 seconds were recognized to be the optimal time of observation for the most precise person's identification.

Technologies used: Assembler, C, C#, Matlab, StatGraphics, UDP protocol.
Front end, analysis software: .NET, WinForms.
Data acquisition software: microcontrollers, Assembler, C, Unix

Smart Guide – Software for Horizontal Drilling Process

Industry: Construction

Customer: (Name withheld according to the NDA) A global provider of advanced steering tools to the North American and European markets.

Country: North America, Europe

Description: Our customer required a highly precise navigation system not depending on accessibility of the surface exactly above the drill-head. The project's objective was to develop a software application allowing to plan a drilling trajectory for laying pipes under the ground, namely for **Horizontal Drilling** (HD) process.

ABTO Software developed a Smart Guide application which embraces the whole process of drilling starting from precise mathematical drilling trajectory planning to immediate device controlling and further saving of project results to the web server.

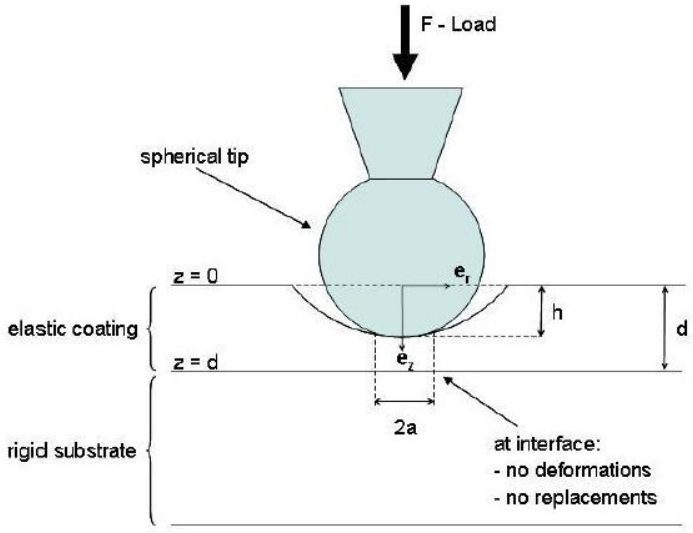
It is a highly precise, advanced navigation and guidance system enabling drilling contractor to choose the most accurate position to bore a hole. The application successfully combines high reliability with rapid task accomplishment.

Tool's Advantages:

- optimal trajectory planning;
- automatic guidance;
- immediate device control;
- project amendment possibility;
- several trajectories comparison;
- history of changes is saved;
- AutoCAD file import possibility;
- possibility to amend the project
- few trajectories comparison option
- history changes view option
- possibility to import AutoCAD file

Technologies used: .NET WinForms, ASP.NET Web Services, ADO.NET, WinAPI, HASP, XML, Numerical Analysis, Applied Analysis, Signal Analysis, various algorithms, Matlab.

Nano-Indentation of Layered Substrate



Picture 1. Model of indentation process

Industry: Manufacturing, Packaging

Customer: DSM Coating Resins **-** one of the world main producers of powder coatings, a global supplier of innovative high-quality resins solutions for paints and coatings, composite materials and fiber optic coatings.

Country: The Netherlands

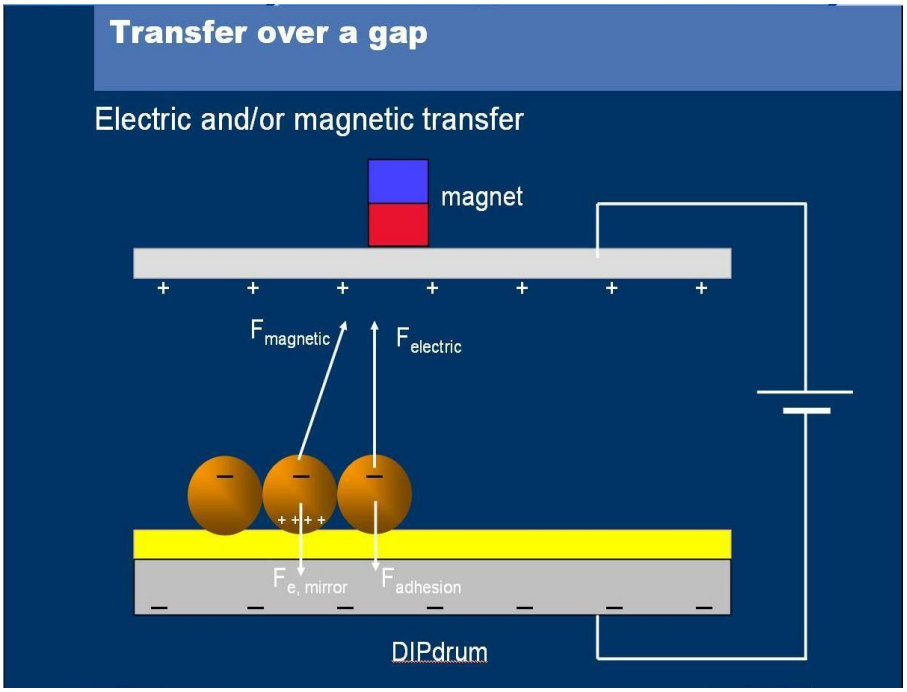
Description: Looking at our daily objects like fridges and washing machines, cars, bicycles, furniture, electronics and electrical devices, we can ensure that powder coatings are widely used in our life. Even substrates such as wood, can, and coil can now be powder coated.

The original challenge of the project was to develop a model that describes the oscillating indentation process of a thin flat viscoelastic coating fixed on top of a very stiff flat substrate. We dealt with the nano-indentation of the thin materials such as powder coatings to determine the mechanical properties of those materials.

Powder coatings are very small in volume; thin film is one example of such material. DSM developed a new method to measure powder coatings - nano-indentation, which is considered to be more reliable than other methods previously used. We at ABTO formulated the mathematical problem for the indentation process, taking into account the influence of a substrate layer, and develop the solution strategy.

Technologies used: Mathematical Physics, Applied Analysis, Elasticity theory, Solid State Physics, Numerical Analysis, Matlab.

Toner Particles Behavior Modeling in Complex Electro-Magnetic Fields



Industry: Electronics

Customer: Océ N. V., acquired by Canon of Japan in 2010 – a provider of a full line range of printers, copiers and scanners for daily office practice, both stand-alone and for network applications.

Country: The Netherlands

Description:
The established goals of this project were:
Use DEM simulations to:

- Determine which effects cause blurring and their magnitude
- Determine how image blurring can be limited
    1. Focussing with electric/magnetic field
    2. Transfer parameters

During the research our specialists derived models for the relevant physical processes in electric/magnetic transfer over a gap. We successfully implemented these models in DEM and validated the program using existing/additional measurements. Our experts also determined the contribution of the physical processes to image blurring.

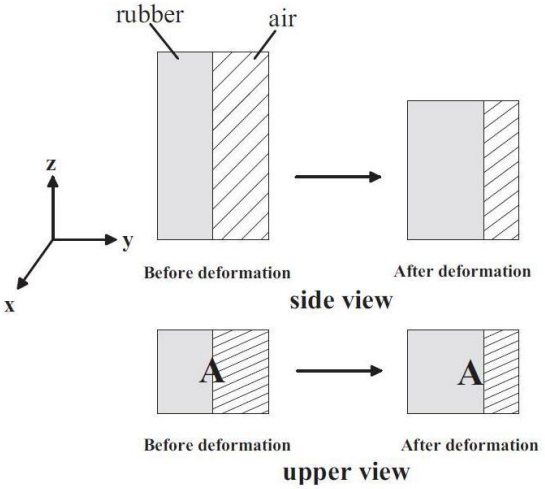
Our software developers built a mathematical model to describe the movement of charged conductive particles taking into account the mutually-induced charges. As a result we successfully implemented an application to run the simulations for different geometries of the environment and configurator of the geometry of the simulation environment.

Experiments' results:

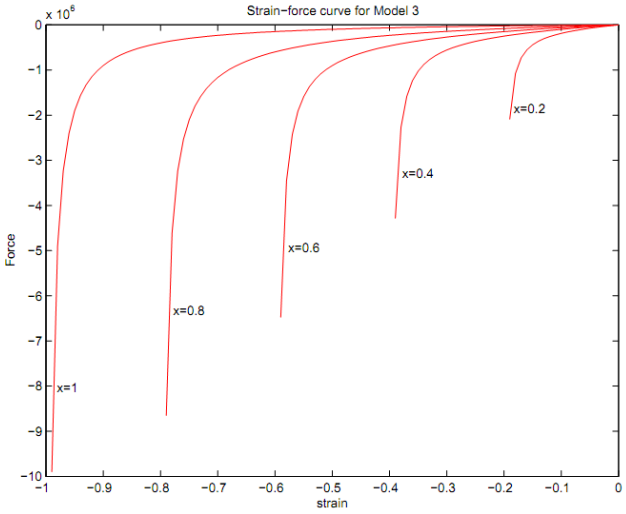
- Large and fast transfer efficiency accomplished
- Edge sharpness deteriorates when transferring over a gap
- Electric + Magnetic transfer has shown an improved front edge sharpness
- AC fields are needed to obtain a large transfer in a short time, but AC fields deteriorate edge sharpness.

Technologies used: C++, FemLab, Mathematical Physics, Matlab, MFC, Numerical Analysis, Design of experiments, Simulations, Electricity and Magnetism, FEM, BEM, Mathematica.

Compression Behavior of Solid Foam



Picture 1. The configuration of model 3



Picture 2. Results for the Unit Cell model

Industry: Electronics

Customer: Océ N. V., acquired by Canon of Japan in 2010 – a provider of a full line range of printers, copiers and scanners for daily office practice, both stand-alone and for network applications.

Country: The Netherlands

Description: Our customer was interested in using solid foam (a combination of rubber and air) for the fuse nip rollers in their next generations of printers. Therefore, we were involved in a project dealing with the behaviour of solid foam under compression.

According to experiments solid foam can perform better than the pure rubber used in printers nowadays. But experiments didn't indicate what has to be changed in order to create the most suitable material for the company's purposes. So we developed a mathematical model to solve this problem.

Experiments' Results:

- We built three different models of foam compression. All models incorporate air fraction and rubber shear modulus as parameters.
- For each model the stress-strain relation in the material was analyzed and corresponding plots were built. The comparison of the results of all models was made.
- Model 3: The Unit Cell was accepted as the most appropriate. In this model, we consider foam made up of unit cells. A unit cell is considered as a rubber unit and an air unit together, shown in the Picture 1.
- In unit cell there is no need to consider the shape of the air and the rubber. We just think about them as units, no matter if they are cylinders or cubes, or of any other shape. By this assumption the model has a wider range of usage in practice.

***Technologies used*:** Matlab, Mathematical Modeling, Elasticity theory, Solid State Physics.

Chuck Deformation due to Wafer Cooling

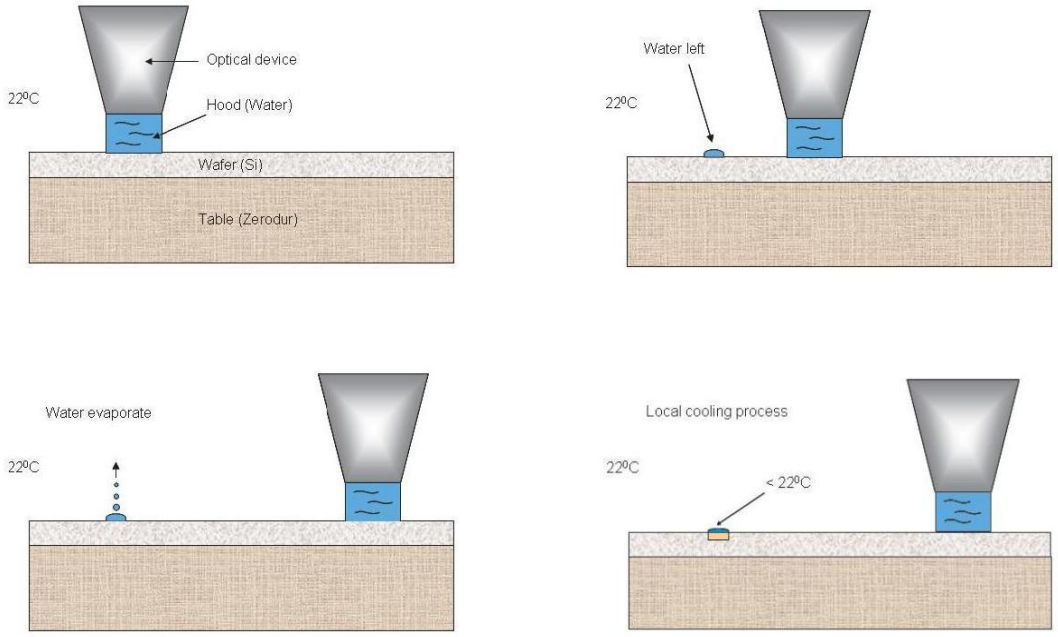


Figure 1: Exposure of wafer process in immersion lithography

Industry: Manufacturing, Nanoelectronics

Customer: ASML – a leading manufacturer of lithography systems for the semiconductor industry.

Country: The Netherlands

Description: Our customer is constantly striving to introduce equipment that enables chipmakers to produce even finer features on chips. Producing smaller features means that chipmakers can in turn shrink the size of their chips, thereby reducing the cost of production, decreasing the amount of energy needed to operate them and increasing their power.

This project's goal was to develop a model that predicts chuck deformation owing to water cooling. We developed a full model that describes the evaporation process of the water layer, the thermal (cooling) process of the wafer and the resulting deformation (warping) of the wafer.

ABTO specialists successfully built a mathematical model to predict the deformations of the wafer online during the exposition process. Knowing the deformations, the position of the wafer can be adjusted to remain in focus.

We formulated a first-order feed-forward model for the warping of the wafer after exposure in immersion lithography. Our experts managed to show that this warping happens due to local cooling of the upper surface of the wafer, caused by evaporation of small water layer left on the surface after the exposure.

Experiments' results:

- The local cooling of the wafer due to evaporation is in the order of 1±C.
- The dimensions of the cooled region on top of the wafer plate, below the evaporate water layer, are of the order of 10^{-3}m, or 1 mm.
- The warping of the wafer is due to thermal shrinking in the cooled region on top of the wafer. This warping can very well be modelled as the bending of a thin plate under inhomogeneous thermal loading.
- The order of the calculated deflections of the plate is 10^{-7}m, or a few hundreds of nanometer.
- The shape of the warped wafer is an upside cup.

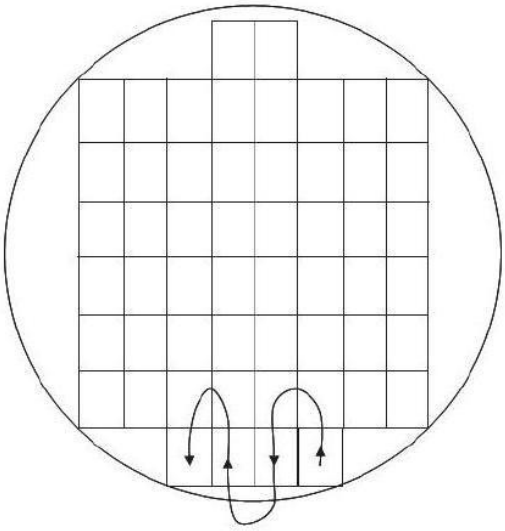


Figure 2: Wafer fields and meander pattern.

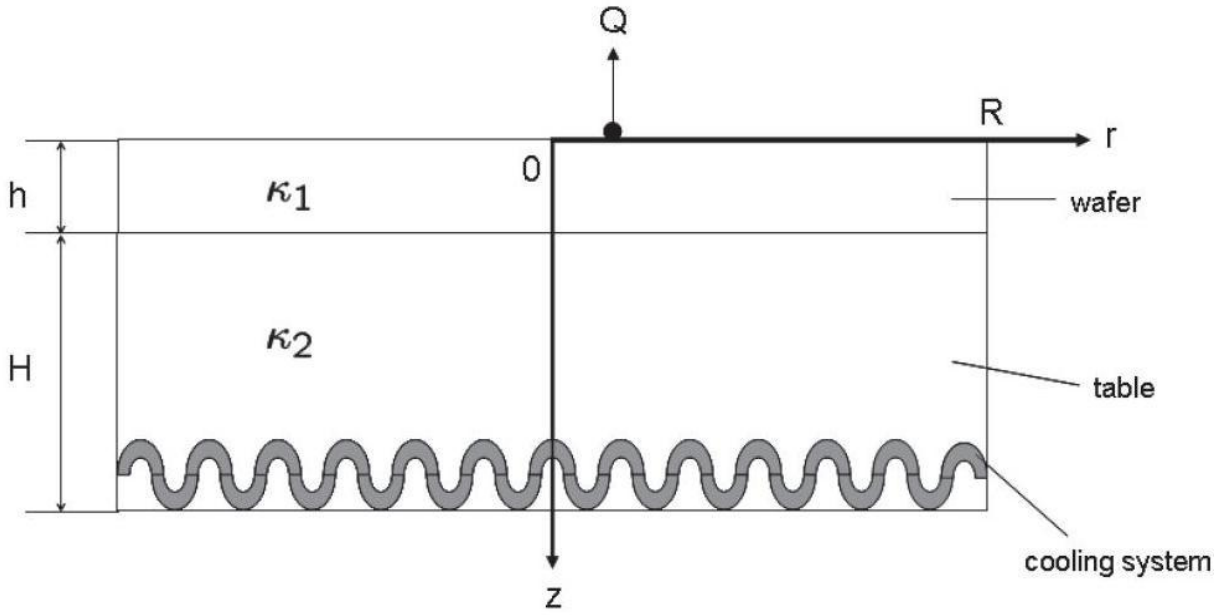


Figure 3: System of wafer on table, with sink Q on top of the wafer.

Technologies used: Mathematical Modeling, Numerical Analysis, Applied Analysis, Thermodynamics, Heat transfer, Diffusion, Elasticity theory, Solid State Physics.

Particles Formation in Polymer-Water-Surfactant Systems

Figure 1—Film formation mechanism for a typical latex paint.

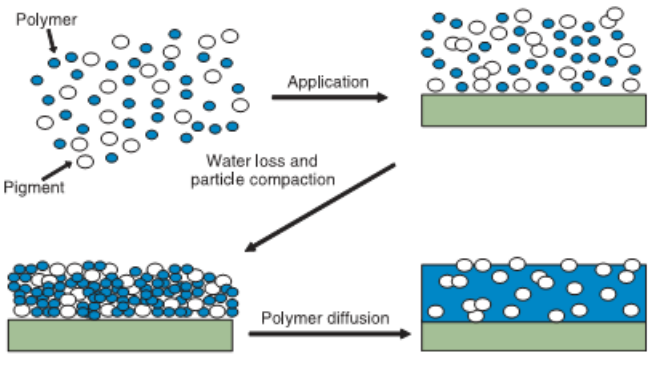
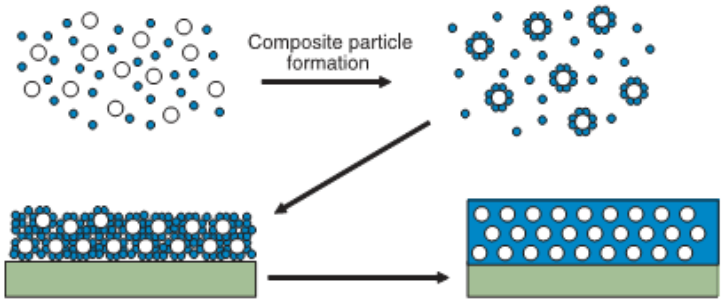


Figure 2—Formation of latex polymer-pigment composites and their effect on the film formation mechanism of latex paints.



Industry: Chemical, Agriculture

Customer: DOW Chemical Company - a chemical company dealing with chemical, advanced materials, agrosciences and plastics businesses and delivering a broad range of technology-based products and solutions.

Country: North America, Europe

Description:

The challenges of this project were:

- Create a prediction model for polymer particles size
- Determine rheological properties of water with surfactant addition
- Find out why more water means larger particles.

During the research we used the following approaches: Micro model (one unit polymer particle) and Macro model (flow of polymer in shear field). Small (microns) solid polymer particles were dispersed in the water.

The final product obtained due to the conducted research has the following advantages:

- Storage and transportation ways are improved
- New materials can be obtained

Experiments' results:

1. We developed two simple models which estimate the size of polymer particles. Both of them have good correlation with literature data.
2. We developed a model giving one of the possible reasons why particles grow when more water is injected in the first step of the process.
3. We reported an overview on the basics of emulsions and emulsification, stability of emulsions, phase inversion and particle formation.

Technologies used: Mathematical Physics, Applied Analysis, Numerical Analysis, Matlab, Molecular Biophysics, Chemistry.