ANSYS ADVANTAGE

Spotlight on Engineering Simulation for

Environmental Design

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It's Getting Easier to **Be Green**

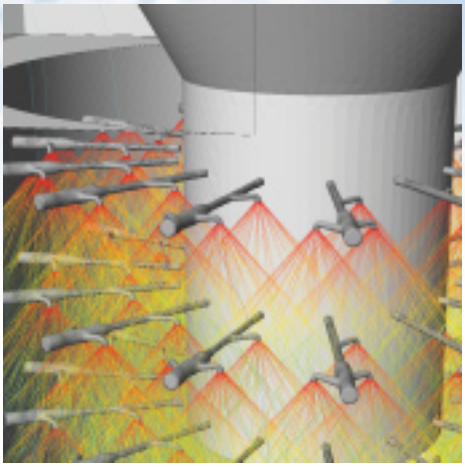
From air to water to power, industries are using engineering simulation to uncover new ways to be environmentally responsible.

By Dave Schowalter, ANSYS, Inc.

The term "green engineering" has become ubiquitous in recent years, with references even on the covers of trade journals and magazines. The U.S. Environmental Protection Agency defines green engineering as "the design, commercialization and use of processes and products that are feasible and economical while reducing the generation of pollution at the source and minimizing the risk to human health and the environment." So while green engineering encompasses environmental engineering, it also can refer to any engineering field in which environmental and human health impacts are minimized. Increasingly, the term has become associated with sustainable development, in which processes and products can continue to be produced indefinitely with a minimum of resource depletion or environmental degradation.

Along with increased awareness of environmental impact, well-known corporations have launched campaigns that show how they are developing green technologies. Of particular note are General Electric's ecomagination™, the BP™ campaign Beyond Petroleum and Chevron Corporation's willyoujoinus.com advertising promotion. One thing is clear: Major companies believe there is money to be made in developing environmentally friendly technology, which should encourage even the most contrarian environmentalist.

In building a better world, global companies are learning that the right engineering simulation can improve efficiency in the design of real-world systems. Simulation capabilities from ANSYS, Inc. are particularly visible in the areas of pollution control, architecture, energy and sustainable technology. This spotlight on the environmental industry provides details about how hard-working users of engineering solutions from ANSYS are improving the environment. Perhaps readers will find themselves inspired.



Particle tracks in a wet SO_2 scrubber in which simulation was used to optimize pollutant capture efficiency. Image courtesy URS Corporation.

Clean Air

Air pollution comes primarily from transportation and point-source industrial processes. In the transportation arena, there is particular emphasis on particulates and nitrous oxides (NOx), with increasing efforts to reduce carbon dioxide emissions through efficiency improvements. Reducing any type of pollution can involve heavy simulation usage for flow, chemistry, heat transfer and thermal stress minimization.

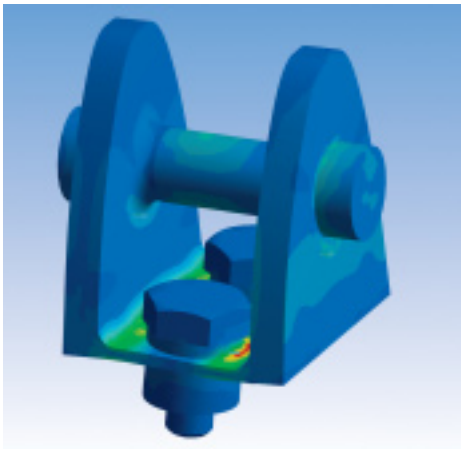
Industrial sources are concerned with particulates, NOx, and carbon dioxide, as well as sulfur oxides (SOx) and mercury. The low pollutant levels achieved today through optimized furnace combustion and optimized flow distribution in downstream pollutant capture systems would not be possible without virtual prototyping through computational fluid dynamics (CFD). Additionally, minimization of material usage requires an understanding of thermal stress loads through structural analysis.

Clean Water

Engineers are using fluid flow modeling — including solutions from ANSYS — to optimize both municipal and commercial purification processes, such as tank mixing, ultraviolet disinfection, chlorination and ozone contactors. Modeling also comes into play in wastewater treatment, which involves similar processes, in addition to phase separation.

Protection of fish is another aspect of clean water, and simulation has been used to design oxygenation systems and retrofits in hydropower dams, that are aimed at increasing downstream oxygen levels. Modeling of water intake structures at industrial plants also is contributing to reduction of ecosystem impact.

Run-off and drift from commercial and residential pesticide treatments can affect water as well as air; simulation is used to optimize chemical dosing, and to model and understand dispersion.



Finite element analysis was used in the design of a solar car, which had severe weight limitations. Image shows the stress analysis on A-Arm clevis for the car's suspension. Image courtesy University of Toronto Blue Sky Solar Racing.

Green Building

Green building refers to designing commercial and residential buildings that minimize non-renewable energy usage; use materials whose production has a minimal environmental impact; and use heating, ventilation and air conditioning methods that maximize air quality. Safely minimizing material usage and maximizing passive ventilation through natural circulation makes this an active and growing area for simulation.

Renewable Energy

Of all renewable energy technologies, wind power has taken the most advantage of simulation capabilities. Today's large wind turbines require advanced materials, increased efficiency, reduced weight while avoiding fluid structure interaction, and the ability to withstand seismic vibrations. Because the power that can be extracted scales as the cube of the wind velocity, placement decisions can have a major impact on the profitability of a project. Other renewable energy technologies that take advantage of products from ANSYS include tidal power systems, solar power installations, and biomass power and energy.

Sustainable Technology

Drastic reductions in energy usage and pollution production are possible with new technologies such as fuel cells, advanced nuclear power plants (including nuclear fusion research), advanced coal power (including gasification) and hybrid automobiles. For these technologies, simulation is in on the ground floor of development, playing an especially active role in next-generation products.

In order to support the ever increasing rate of technology development that is required for global environmental sustainability, computer aided engineering tools themselves must be scalable and sustainable, which is why ANSYS gives the highest priority to developing multidisciplinary, multiphysics tools all within a single accessible environment, deployable on the desktops of engineers in the small venture start-up as well as on the large parallel servers in engineering departments of major multinational corporations. ■

References

[1] U.S. Environmental Protection Agency, http://www.epa.gov/oppt/greenengineering, 2006.