Fall 2005

Many opportunities arise from challenges. It now appears we are facing a long term, if not permanent rise in the cost of conventional fuels. For many of our customers, energy costs are already a significant portion of their total operating costs. As these costs begin to balloon in proportion to other expenses, those growers that find ways to trim their energy costs will gain a significant advantage over those who do not. That is the challenge.

Given the current situation, we feel strongly that every customer should review their current and future energy situation. There are many opportunities to reduce energy costs and improve energy efficiency. It is likely that there will be a rekindling of the same interest in energy conservation, and alternate energy sources and heating methods that followed the OPEC oil embargo in the 1970's. The difference this time is that high energy prices may well be here to stay.

Options range from improving the performance of the equipment you already own, to retrofitting with more efficient systems, to adopting less conventional heating methods. In all cases, effective control of these heat sources is a key to extracting the maximum value from them.

That's where Argus can help. In the next two newsletters we'll discuss heating, and ways that you can use your Argus system to manage energy use while meeting your crop targets.

Alec Mackenzie

ARGUS CONTROLS

ARGUS ADVISOR

News for Argus Control System Owners

Heating Control - Sources of Heat

High Mass Boilers

In this issue we discuss the control implications for the equipment used to provide heat in greenhouses. While our focus here is on greenhouses, the same principles apply to all heat applications. Our next issue will focus on control of heat distribution systems.

There are of course, many heating methods used in greenhouses and the first thing you tend to think of may be boiler systems or unit heaters. We sometimes forget that the primary heat source for greenhouses is the sun. The very purpose of a greenhouse is to capture the sun's energy - both its heat and light. A significant amount of the machinery in your greenhouse is devoted to managing and regulating this energy source, since the amount of energy the greenhouse receives from the sun is constantly fluctuating. One of the most important uses for automated control systems has been to manage this often unpredictable heat

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Canadian Greenhouse Conference
Location: International Center
Mississauga, Ontario,
www.canadiangreenhouseconference.com
See us at **Booth 460**

Nov 2 - 5th
International Hortifair
Location: Amsterdam RAI
Amsterdam, The Netherlands
www.hortifair.nl
See us at **Booth 05.0106**

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source through ventilation, exhaust fans, and shade systems.

You can think of all other heat sources as supplementary, since we mostly use them when there is insufficient heat available from the sun. Conventional heating sources can be grouped into a number of classes based on either the energy source they use (electric, oil, coal, gas, etc.) or the medium that is being heated and distributed (air, water, or steam), or whether they are centrally located, or distributed throughout an operation.

There are also many less conventional heating strategies including combined heat and power systems (CHP or 'Cogen'), heat storage and heat buffering systems, heat pumps, solar storage and recovery systems, industrial waste heat sources, and geothermal. There are also a number of less conventional (and sometimes controversial) fuels such as wood products, crop wastes, and garbage, including tires and other combustible refuse.

Multi-Boiler System
Photo Courtesy TrueLeaf Technolgies

Control Considerations

Good control starts with good system design. The better designed your system is, the easier it will be to control and manage, and the more efficient it will be.

The ideal heat source would instantly produce the exact amount of heat required to match the current requirements. Although some heat sources can be modulated to a degree, there are always some differences in the amount of heat being generated, and the amount that is actually needed moment to moment. In controlling your heating source, you need to balance 3 sometimes competing needs:

- the needs of the crop
- the need to minimize heat costs
- the need to respect the physical limitations of the equipment systems (ramp-up delays, short cycling and cold shock protection, etc.)

Whether you are considering a retrofit, a supplementary heat source or a complete change of systems, you need to plan for system automation at the outset. All facets of a sound heating strategy need to be controlled and coordinated with other processes. We have seen many instances where the basic idea was sound, but the system was poorly executed with respect to automation, making it difficult to control, overly complex, and ultimately compromising efficiency.

Insulated Heat Storage Tank

The requirement for control coordination increases as you combine multiple heat sources such as ganged low mass boiler systems, or supplementary systems such as heat buffer tanks, flue gas condensers, and less conventional heat sources such as heat pumps, solar storage and recovery.

With careful use of the capabilities of your control system, you can protect your equipment, reduce unnecessary cycling, maintain better setpoint control, and reduce waste.
Argus has extensive experience in controlling and integrating all types of conventional and less conventional heat sources. Let us know if you are contemplating new alternatives or retrofits. We'll be happy to assist in your planning process. In reviewing your plans, we can often suggest modifications or improvements that will facilitate better control, simplify your design, and coordination with other controlled systems.

3 Ways to Improve Energy Efficiency

In approaching the challenge of rising heating costs, you are faced with the systems you have already invested in, and possibilities for alternative systems. Obviously, getting the most from the systems you already have would seem a natural first step, unless you have discovered a vastly superior alternative.

Conserve - Find ways to produce the same crop output with less energy inputs. This includes improving equipment efficiency and reducing heat loss. In the longer term it could also include switching to crops and varieties that require less heat. Beware of false economies. Simply turning down the heat could greatly extend cropping time (you could end up using more energy!). It could also alter the plant habit, increase disease and losses, and have a negative effect on bio-control agents. Fixed or moveable thermal screens are obvious candidates if you haven't already installed them, as are many of the other insulating and conservation measures that were promoted in the 1970's and 80's.

Increase Output - Find ways to produce more output using the same inputs. Even if you don't reduce your total energy bill you may be able to reduce your fuel costs per unit sold. Better space utilization, faster crop turnarounds and any management improvements that will increase crop uniformity and reduce losses will ultimately improve your energy efficiency.

Explore Alternatives - Changing heat sources can be daunting. Any less expensive heat source that fits well with your existing heat distribution methods, is initially more attractive than one that requires extensive retrofitting of the entire heating system. For example, changing from an oil burner to a wood waste boiler will have few consequences for the rest of your existing heating system, while switching from a hot water boiler to a low grade (large volume, low temperature) industrial waste water source could require major changes to your entire heat distribution system. Other factors you need to consider are:

- Environmental considerations
- Long term security of price and supply
- Investment cost and projected payback
- Control automation and integration with other equipment systems

Alternate Heating Methods

Combined Heat and Power Systems (CHP or 'Cogen') - these systems use combustion fuels to operate turbines or reciprocating engines to produce both electricity and heat. The electricity that you generate can be used for your operation and surplus amounts are sold to your utility. Although significant savings are possible, the practicality of these systems usually depends on the willingness of your local utility to participate in distributed power generation schemes. Other novel approaches include using the electricity generated to operate ground source heat pumps.

Heat Storage and Buffering Systems - these systems do not actually generate heat, they store the heat generated from gas boilers, flue gas condensers used for CO_2 supplementation, or excess solar heated air from the greenhouse. They can also be used to completely decouple the main heat source from the distribution system by heating a storage reservoir (i.e a buffer tank) that is then 'tapped' by the distribution system. Argus has designed control solutions for many types of heat storage and recovery systems. Other applications include 'closed greenhouse' concepts where instead of venting hot air in the daytime, these experimental systems capture and store excess solar energy for later recovery .

Waste Heat and Geothermal Sources - Some operators may be able to take advantage of locally available sources of industrial waste heat or geothermal heat located below ground. Often these are part of a larger, area wide scheme to tap underground heat.

Saving Energy by Heating for the Day

Your Argus system contains many features for optimizing energy use. One example is the **Cooling Light Increase/Decrease** settings. For some crops, you may be able to reduce your climate temperatures by a few degrees on dull days without adverse effects. With these settings, on dull days the climate temperature is held to a maintenance level, in keeping with the amount of available light for photosynthesis. On bright days the temperature is allowed to increase for maximum photosynthesis activity.

Here's how it works:

Let's say you want your cooling target (maximum zone temperature) to rise by up to 5°C with increasing light levels. For this, you would first enter the minimum daytime heating and cooling setpoints for your crop in the **Normal Setpoints Schedule**. These are the lowest daytime zone temperatures to be used on the dullest, most overcast days. Next, by setting up a **Cooling Light Increase** for your climate on the **Heating and Cooling Target Modifiers** screen, the system will automatically allow the temperature to rise on brighter days.

Here's an example:

Cooling Light Start: 100 Wm^2
Cooling Light End: 1000 Wm^2
Cooling Light Setting: 5°C

With the above settings, the light increase will not begin until light levels reach 100 Wm^2. Once light levels increase above the start level, the control system allows the cooling target to rise up to 5°C over the span between 100 and 1000 Wm^2 light energy. As light levels fall below 1000 Wm^2, the modifier will be decreased accordingly until light levels reach 100 Wm^2 at which point the modifier will no longer be in effect.

The Cooling Light Increase is passive - only the sun is used to raise the climate temperature. If you wish to force the minimum temperature to rise on sunny days, you can also set a corresponding **Heating Light Increase** which will use the heating system to raise the temperature when required.

Multi-day Averaging

A further extension of this concept is the **Multi-day Averaging** program. It can be used to offset the growth gains made on bright days by automatically reducing the temperatures on subsequent dull days. This 'heat balance' approach can be used to reduce energy use and help with crop timing and scheduling. For more information on this program, call Argus.

A word of caution:

While reducing daytime temperatures in dull weather could result in significant energy savings, keep in mind that there are other reasons for maintaining temperature setpoints besides matching the temperature to photosynthesis rates. These include growth management, humidity control, and disease prevention. You should always consult a crop advisor before substantially altering growing temperatures.

Fall Heating Control Checklist

- ✓ Clean the filters on all aspirated sensors and make sure they are properly positioned in the crop
- ✓ Test humidity sensors for proper operation
- ✓ Make sure your weather station sensors are operating properly
- ✓ Make sure all alarms and program defaults are set for winter conditions
- ✓ Make sure all controlled heating outputs and relays are set to automatic
- ✓ Review all heating/ventilation setpoints and climate control settings
- ✓ Review and test all heating equipment programs
- ✓ Test thermal curtain operation and review control settings
- ✓ Make sure all critical values are being data recorded
- ✓ Set up data recording reports to quickly review heating system performance
- ✓ Test mixing valves and pumps for proper operation
- ✓ Test fire all boilers and unit heaters before you need them

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