Restaurant Operational Efficiency: Smart Commercial Kitchens

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Summary

- Commercial kitchen equipment such as ovens, fryers, and refrigerators are increasingly being connected to the cloud
- While data from these systems can be used to automate Food Safety reporting and reduce energy consumption, there are many additional benefits from connectivity, including:
  - Controlling oil costs in fryers through remote visibility into system usage
  - Tracking and preventing product quality issues in fryers and ovens
  - Catching performance problems in refrigeration systems before they become expensive and dangerous problems
  - For manufacturers: reducing the cost of customer support through remote trouble-shooting

Introduction

Much has been said about the energy benefits of internet-connected and remotely controlled equipment in small commercial facilities such as restaurants. The case is clear for connectivity when controlling energy consumption - for example, connected thermostats provide comfortable yet efficient temperatures for guests and staff, and controllers enforce commercial kitchen equipment on/off schedules to eliminate excess energy use.

With the infrastructure in place to provide energy control and analytics in a restaurant, though, are there other opportunities for driving greater operational efficiency through connected equipment? If so, what are the potential benefits of the "smart" commercial kitchen (the kitchen with connected equipment) when it comes to operating costs, equipment performance, and product quality?

This white paper will focus on opportunities for improving restaurant kitchen operational efficiency through the use of connected cooking and food storage equipment, including fryers, ovens, and refrigeration. We will describe not only the opportunities for restaurant operators but for kitchen equipment manufacturers and service organizations, as well.

Fryers

Image courtesy of Henny Penny

To many restaurants, particularly QSRs, fryers are one of the most critical pieces of cooking equipment due to their expense and to their impact on product quality. Fryers represent a substantial capital investment; a typical 3-vat fryer can cost tens of thousands of dollars, and fryers demand a high operating cost. While fryers are energy hungry, oil costs -- running hundreds or even over one thousand dollars per month -- dwarf fryer energy costs. According to fryer manufacturer Henny Penny, "after food, it's likely that oil ranks near the top of most operators' lists of costs surrounding their frying operations."

In addition, well-run frying operations help to ensure customers get a consistently delicious product. For both cost containment and customer satisfaction, it is critical that restaurant operators drive best practices in fryer operations across all of their locations, which requires visibility into every fryer at every restaurant.

In 1967, Dr. C.J. Robertson performed research on frying foods and determined the five elements to an effective process. His work was published in an article in *Food Technology Magazine*[1]. Despite being more than 50 years old, Dr. Robertson's principles are still highly relevant today. A proper frying process requires that restaurants:

1. Properly design, construct and maintain frying equipment
2. Operate fryers properly
3. Minimize exposure of oil to ultraviolet (UV) light
4. Keep salt and other metal sources away from the oil
5. Filter oil regularly

1. Robertson, C.J. 1967. The practice of deep-fat frying. Food Tech, 21:1, 34-36

While operators typically have no control over the design and construction of a fryer, they do have direct control over Dr. Robertson's other principles. One of the most common problems in frying results from skipping oil-filtering cycles (principle 5). Filtering oil helps to extend its life and maintain its quality. Oil left unfiltered can adversely affect the taste and texture of fried foods. As a result, unfiltered oil needs to be disposed of more frequently, causing needless expense. Modern fryers can guide operators when filtering is required and can also track when filter cycles have been skipped. The oil filtering data is often stored locally on the fryer, which may be used by the local restaurant manager, but lack of centralized access makes it challenging for any multi-site operator to take advantage of insights this data may be able to provide. Remote visibility into filter changes thus protects both product quality and the bottom line.

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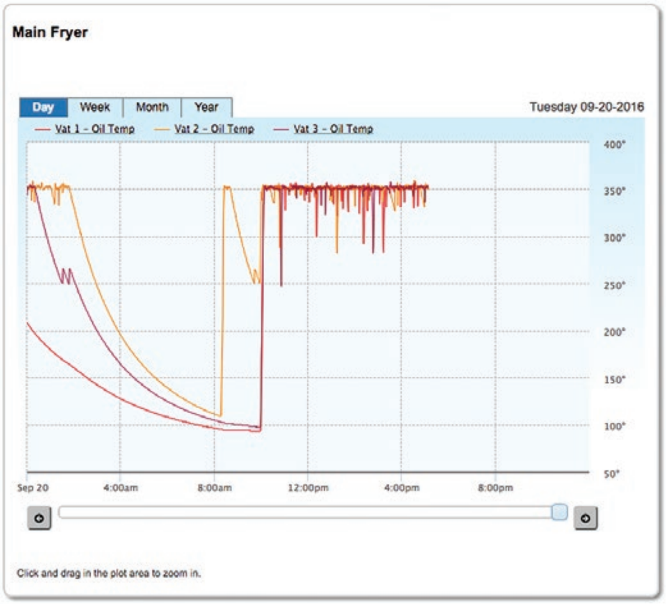
Another common challenge with fryers is ensuring the oil is held to the right temperature (principles 1 and 2). We've all experienced soggy fries but may not be aware of what causes them. When a fryer's oil temperature is too low, the fries take longer to cook, sitting in the oil for a longer period of time, soaking up more oil. More oil absorption results in soggy fries. Fryers in need of repair may be unable to maintain the proper oil temperature during repeated frying cycles. Their "recovery time" between batches is too long, which results in food being cooked at a too-low temperature – making those fries soggy.



Tracking oil temperature over time in each of three frying vats

Thanks to the increasing availability of data in the cloud from connected equipment – including fryers – it is now possible for restaurant operators to have visibility into their frying operations across their enterprise. Modern fryers typically have a small computer or "controller" on board that collects data on how the system is being used and how it is performing. These controllers can connect to the Internet through various means, including through wireless modules that communicate with a restaurant's asset and energy management system.

Because of this connectivity, it is now possible for multi-site operators to track and correct critical problems across their enterprise, such as oil filter skips and poor oil temperature recovery times.

By quickly addressing problems and enforcing Dr. Robertson's best practices in frying, operators can reduce their monthly oil expenses while helping to ensure product quality is consistently high across all locations.

"Getting relevant, actionable data from our equipment into the cloud gives our partners information they need to make decisions to improve and build their business. The decisions range from best practices to quality control to preventative maintenance—impacting operating costs and the ability to serve consistent product all day, every day."

Rick Cartwright, Director of Product Management, Henny Penny

Fryer Summary Report Covering 09/01/2016 - 09/27/2016

Location #2793 | #1300

	Vat 1	Vat 2	Vat 3
Oil Usage			
Used (Gal/Liter)	43.4	100.7	37.6
Used per day (Gal/Liters)	2.3	5.7	2
Added (Gal/Liters)	7.4	129	64
Added per day (Gal/Liters)	3.9	6.8	3.4
Disposals (#)	0	1	0
Avg. Days per Disposal	N/A	27	N/A
Filtering			
Filters	50	49	38
Bypassed Filters	7	4	5
Filters per day	2.6	2.6	2
Bypassed Filters per day	0.4	0.2	0.3
Utilization			
Total Cook Cycles (#)	**1079**	**1001**	**808**
Cook Time (hrs.)	**170.7**	**176.4**	**170.4**
Avg. Cook Time (hrs.)	**0.2**	**0.2**	**0.2**
Idle Time (hrs.)	**78.3**	**71.3**	**80.3**
Avg. Idle Time (hrs.)			
Cooks per filter	**21.6**	**20.4**	**21.3**
Cooks per lb oil	**0.9**	**2.2**	**1**
Cooks per disposal	**N/A**	**1001**	**N/A**
Temperatures			
Avg. Cooking	394.7	345.7	347.4
Avg. Idle	123.7	125.4	118.9
Avg. Recovery Time	64.3	64.6	65.5
Avg. Initial Heat Up Time	N/A	N/A	N/A

A fryer report tracking oil usage, filtering, utilization, etc.

Ovens

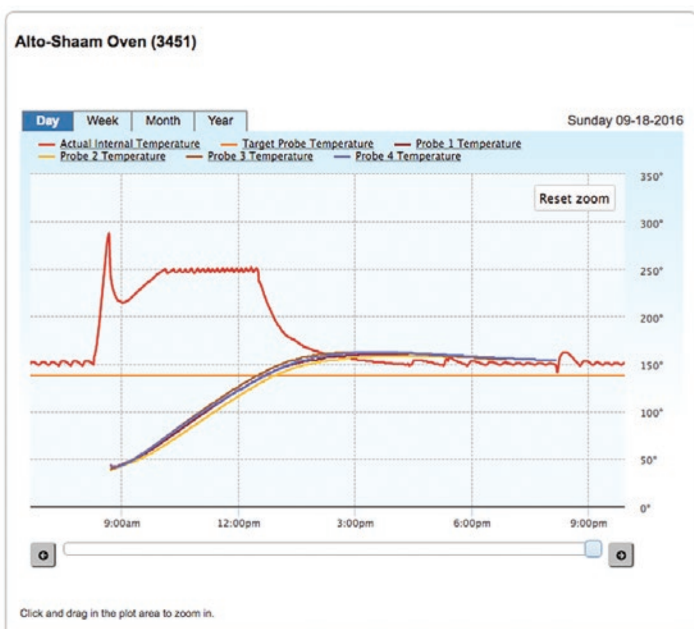
Commercial ovens are another critical component of cooking operations. As with modern fryers, modern ovens may collect data key to the operations of a restaurant. Many units use probes to track the temperature of the food as it is being cooked – both as a means for collecting data on food safety and as a means of triggering the end of a cooking cycle when the temperature of the food has reached its targeted value.

Modern ovens are also commonly designed to make the cooking process as foolproof as possible, with menu-based displays that allow an operator to select the item being cooked, launching a pre-programmed cooking sequence. This data can be used to track which items were cooked in which unit, and when.

Similar to frying operations, centralized access to oven data across an enterprise can empower operators to quickly identify and correct problematic behavior, processes, or equipment issues that can affect food yield, quality, and safety.

Image courtesy of [Alto-Shaam]

For example, a QSR customer of ours with a connected oven recently received multiple alerts indicating the protein that had been cooked was unsafe and should be discarded. Frustrated by the waste and the expense, the operator contacted the oven manufacturer for help diagnosing the issue. With remote access to the data from the oven, the operator was able to determine that the protein was being placed in the oven before it had completely thawed, preventing the food from reaching the appropriate final temperature. Based on the data from the system, the operator was able to clearly identify this as a training issue, which was quickly resolved with the staff, preventing further expensive waste and removing the risk of serving under-cooked food.



Oven temperature and food temperature over time

Having access to cooking data in ovens can also help operators improve yield and reduce product shrinkage. Cooking yield is the change in food weight due to moisture loss or fat loss during the cooking process. According to a 2012 study by the U.S. Department of Agriculture, cooking yields of different meats can vary by 20% or more, depending on cooking methods, meat type, and fat content. Across a large chain, even a 1%-2% change in cooking yield can result in millions of dollars of additional, or lost, profits. Tracking product yield is therefore an important part of effective operations management.

Raw food temperature, cook time, and hot holding time all have an impact on the quality and yield of the final product. Insufficiently thawed proteins such as beef or poultry take longer to cook, resulting in yield loss and compromised quality.

Enterprise-wide visibility over these cooking parameters can help operators quickly root-out the locations and ovens experiencing problems and take action to correct employee behaviors or equipment problems. Solving these issues can result in significant bottom-line improvements.

Refrigeration

Image courtesy of Traulsen

As with cooking equipment, tracking refrigeration temperatures is critical to maintaining safe food conditions and can be used to help automate data collection and reporting. Today, advanced refrigeration units have controllers collecting data on far more than simple chamber temperature, including:

- Evaporator temperature
- Dry bulb temperature
- Relative humidity
- Liquid line temperature

Having remote access to this expanded information can enable technicians to drive down equipment repair and maintenance costs. We explain each of these parameters, and their impacts on equipment performance, on the next page.

While chamber temperature gives a real-time indication as to whether the conditions inside the box are compliant with safety standards, a non-compliant refrigeration temperature is often a lagging indicator of a problem with a unit.

Accessing other data points can provide a refrigeration technician with leading indicators of looming issues before they become expensive problems. And using leading indicator data allows for maintenance calls to be scheduled at lower-cost times of the day, requiring only a single site visit with the needed materials, instead of multiple visits to diagnose and then perform service.

For example, refrigeration evaporators – the part of the refrigerator that removes heat from inside the chamber -- should typically run 10° to 15°F colder than cabinet temperatures.

Image courtesy of Master-Bilt

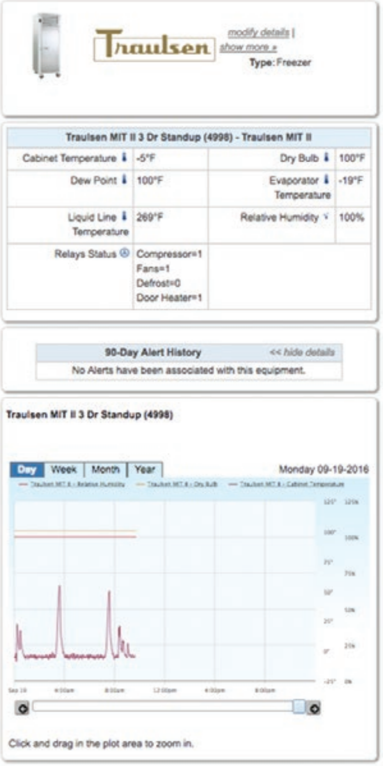
A freezer's evaporator may run at -15°F or -20°F, while the freezer cabinet measures -5°F or 0°F. Occasionally, the temperature of the evaporator will spike to 45°F to 50°F or so as the coils go through a defrost cycle, dropping again to expected temperatures at the conclusion of the defrost cycle. The absence of a temperature spike for a prolonged period of time (e.g., 24 hours or more) suggests a unit is experiencing a problem with the defrost process, and excessive coil icing with degraded refrigeration performance can result. Conversely, a lower-than-normal evaporator temperature suggests a restriction in the evaporator system.

Dry bulb temperature measures the air coming into the refrigerator's condensing unit, indicating the temperature of the ambient environment outside the refrigerator or freezer. A refrigeration unit placed in an area with excessively hot conditions (e.g., 105°F-110°F) can struggle to maintain the proper temperatures inside its chamber. With access to this ambient temperature information, a refrigeration technician can recommend the unit be moved or the source of heat (e.g., an oven) be moved so the unit can operate properly. Clearly this is preferable to rolling a truck only to find a refrigeration unit operating properly but simply placed in poor conditions.

Tracking liquid line temperature can root out condenser fouling (when it shows a very high temperature) and having data on ambient humidity around a refrigeration unit can help to explain condensation such as sweating around the door frame.

This is not an exhaustive list of data available data to refrigeration technicians to help them do their jobs more efficiently. Other data such as number of door openings, compressor run times, and number of defrost cycles can also be used to further pinpoint diagnoses of issues.

Technicians can take advantage of remote access to this advanced diagnostic data to determine the root cause of a problem before going to the customer location – enabling proactive service calls and repairs more likely to succeed the first time.



Refrigeration system key performance metrics

Equipment manufacturers

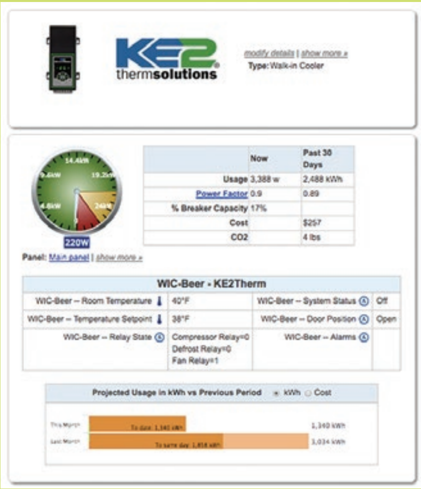
While operators can reap multiple benefits through enterprise-wide access to data from their critical kitchen equipment, equipment manufacturers also stand to benefit.

Without connectivity to equipment and the data it produces, equipment manufacturers typically have very few options to resolve problems that their customers report. Commonly, they will roll a truck and a technician to the site. Not surprisingly, this is an expensive way to provide responsive service to their customers. With remote equipment visibility, manufacturers are able to gather data to get to the root cause of a problem before sending a technician to the site. Sometimes, the issue can be resolved without sending a technician at all.

In addition, many types of modern kitchen equipment can generate alerts when they detect problems. With cloud-connected equipment, manufacturers can be on the receiving end of the alerts, enabling them to react to problems before the customer may even be aware there is a problem.

"The contents of our customer's refrigeration units are critical to their operation. It's important to know that the units are holding temperature 24/7 regardless of kitchen operating hours. Having remote access to performance data is like an insurance policy that ensures our customer's kitchen runs smoothly and that they have one less thing to worry about."

- Chris Henderson, Engineering Manager, Traulsen



Remote access to alerts and critical equipment data

Third, having remote access to their installed base of equipment at customer sites can help alleviate a non-trivial challenge in supporting manufacturers' customers: upgrading firmware and menus. For non-connected equipment, manufacturers will typically mail a thumb drive with the new version of firmware or menus to the location with instructions on how to upload it to the equipment.

Because of this structure, manufacturers are exposed to the risk that the updates may not get uploaded to their systems consistently across all locations, making it more difficult to support an installed base with different versions of firmware or menus.

Finally, manufacturers may be able to integrate the data from their equipment with a platform that pulls multiple disparate systems in a commercial kitchen onto a single software platform. As national chains seek connectivity solutions to improve visibility and operational efficiency, they are quickly coming to realize that managing multiple software interfaces, user accounts, and passwords is unwieldy at best. Having one system to control and diagnose HVAC, another for fryers, a third for ovens, etc., is not a scalable solution that can effectively address the complex operational challenges faced by organizations managing many locations. As a consequence, they pursue technologies that can provide a single platform for accessing data from disparate systems. By being a part of a single platform, a manufacturer's equipment becomes part of a compelling and scalable enterprise solution.

Conclusion

As more and more commercial kitchen equipment manufacturers add intelligence and connectivity to their systems, restaurant operators – and equipment manufacturers themselves – stand to benefit from access to this data. The operational benefits of connectivity can extend beyond reducing energy consumption and automating food safety tracking. With intelligent reporting and analysis of equipment data, there are significant opportunities to reduce operating costs, maintain high product quality, reduce repair and maintenance costs, and drive higher equipment uptime. Finally, modern commercial kitchen equipment can become part of a scalable enterprise solution by integrating with a platform capable of working with multiple systems, delivering a single unified user interface that facilitates enterprise analytics and controls to drive enhanced operational efficiency.