ILLINOIS INSTITUTE OF TECHNOLOGY

IPRO It takes a team!
INTERPROFESSIONAL PROJECTS PROGRAM
AT ILLINOIS INSTITUTE OF TECHNOLOGY

Harvesting & Beneficial Use of Condensate from Air Conditioning Systems

Pentair

Project Sponsor: Pentair Inc.

IPRO 346, Summer 2011

Illinois Institute of Technology

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1. Executive Summary

Sustainability is one of the great challenges of our time. The purpose of this project is the advancement in knowledge of, and applied practical solutions to the challenges of sustainability in regards to a very specialized area of water conservation. The harvesting of air conditioner condensate could potentially lead to the conservation of a great deal of both water and money. Pentair, a company specialized in providing water solutions, is interested in the technology to harvest the condensate from A/C in buildings, and is our sponsor. We aimed to create public awareness surrounding the potential non-potable use of air conditioner condensate through demonstration and presentation.

In order to accomplish our goals more effectively, we divided our team into two sub-teams, each having a different focus. The prototype team was responsible for both the design and construction phases of both the scale model and prototype, while the marketing team worked on reaching out to interested parties and the creation and maintenance of the Facebook and Twitter accounts. There was a considerable overlap regarding individual roles, but these sub-teams were created none the less. Many individual roles were also specifically designated in order to keep the project team organized, coordinated, and running smoothly.
It has been determined that interest in the subject is present, and interested parties do exist. While the Twitter account didn't have the effect we expected, the Facebook page was liked by a fairly high number of people. The prototype team was able to design and construct a working scale model for use in presentations, and also created a prototype proposal stating both the specifics and cost of a system capable of harvesting air conditioner condensate to water gardens or grass. Although not many presentations were given, the marketing team successfully contacted several organizations interested in the concept, and was able to schedule a presentation in Chicago.

It is our recommendation that this project be continued, as we have only really scratched the surface in regards to informing interested parties and motivating change in public policy. We feel future teams could accomplish a great deal using the tools we have created this term, ultimately starting a movement towards a greener tomorrow.

2. Purpose and Objective

Condensation is the process by which water vapor becomes a liquid (condensate). Cooling systems rely on evaporator coils which refrigerant fluid changes from liquid to vapor, cooling the coils in the process. Air blowing past the coils cools off as it goes by, and moisture from the air condensates on the coils. Condensate drains carry away the water, usually to the sewer. Instead of wasting it, the water could be harvested for reuse.

Sustainability is the challenge of our times. One of the purposes of IPRO 346 is the advancement of knowledge for applied practical solutions to the challenges of sustainability. The harvesting of condensate is one of the many ideas that promote sustainability. Pentair, a company specialized in providing water solutions, is interested in the technology to harvest the condensate from A/C in buildings, and is our sponsor.

In identifying alternative sources of water, one of the first considerations is what those sources will be used for. Potable water, which can be used for drinking, cooking and bathing, among other uses, must meet a high level of purity and safety. Non-potable water is less pure but when handled properly, it can be fine for landscaping irrigation, makeup water for cooling towers, and toilet flushing. Many alternative water sources are suited for non-potable uses, like air conditioning condensate. If we could provide separate plumbing in and around buildings for potable and non-potable water, it opens up significant new options for water supply. One of the biggest challenges facing the use of water from condensate is regulations. Most states do not permit separate collection and use of this water, though severe droughts have helped to ease those restrictions in some regions. For example Arizona State University has created a system for water capture: water from the Bio-design Institute's air-conditioning system is harvested in a 5,000-gallon cistern for landscape irrigation. This provides enough captured water to eliminate the use of tap water for irrigation. Also the University of Texas in Austin has had a program for water recovery since 1980s. This program has recycled more than 1.3 billion gallons. The water is used to offset evaporation in their cooling towers.

In large commercial buildings, condensate recovery often produces enough water to supply all the landscape irrigation needs. Also air conditioning condensate harvesting is most practical in climates with high humidity like Chicago and condensate recovery is especially attractive in

facilities like shopping centers or office buildings. A 10,000 square foot office building can produce more than 15,000 gallons of condensate water per year. The benefits of the use of condensate are clear; a single lawn sprinkler sprays approximately five gallons of water per minute at a medium flow rate or 10 gallons per minute at a high flow rate. There is saving in water, energy and money.

Some ethical concerns which we identified were: while air conditioner condensate is inherently pure, as it is essentially distilled water, there is a potential for contamination, especially if the water sits in a warm environment. Also the water is classified as non-potable, so the uses we concentrated on were flushing toilets and watering plants/irrigation. The water was to be never used for human consumption as it may contain heavy metal from contact with the cooling coils and other HVAC equipment. The lack of minerals in the water also made it corrosive to most metals, especially steel and iron. The water's low mineral quality and lack of sanitizers (chlorine, chloramines, etc.) made it excellent for the purposes of irrigation.

The main purpose of the IPRO Team of Summer 2011 was to advance the work done by the IPRO teams of previous two summers with the focus on building public awareness and building an actual real time model. The public awareness was to be created by using the social networking sites like Facebook and Twitter. Another major objective of this IPRO was to alter the public policy by contacting governmental and non-governmental organizations. Our IPRO team also aimed to build a scale model and a prototype condensate collection system to utilize the condensate usage on the IIT campus itself. Another purpose was to identify the practical and political barriers to the main stream harvesting of condensate and develop action plans to overcome the barriers. In short, the two main goals of the Team were to build public enthusiasm for condensate harvesting via social media and secondly to summarize all IPRO condensate efforts into a presentation with collateral materials and share it with organizations that have outreach missions of sustainability and conservation.

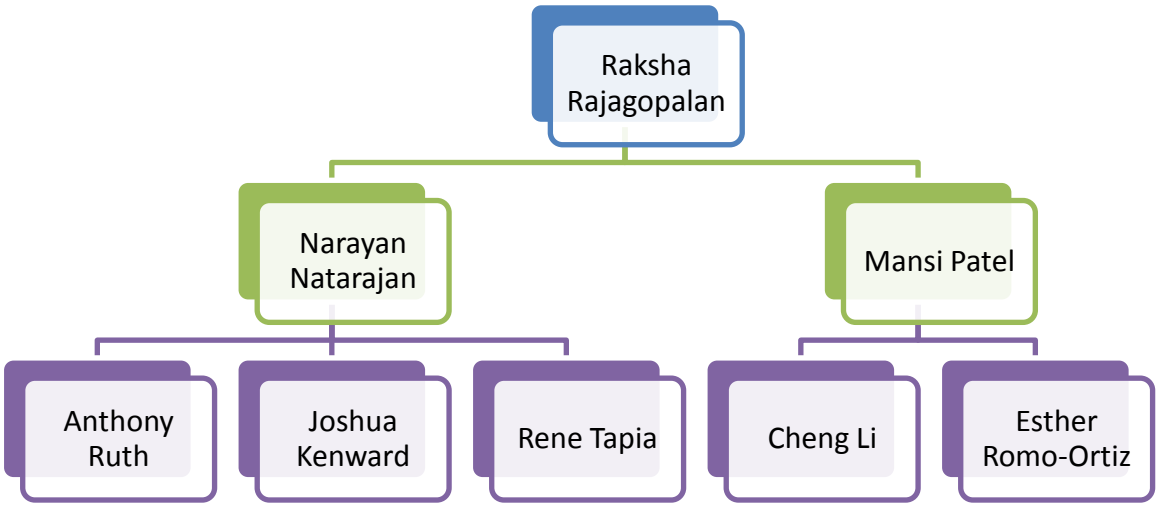
Our project if continued further over time and taken up as a mission by the government or any non-profit organization would not only benefit the people in general, but the country and the world as a whole as it aims at saving and reusing water. It would actually help sustain water in

our community over a longer time, along with planting more trees and flowers, leading to a greener Earth!

3. Organization and Approach

a) Subgroup Deliverables and Responsibilities

The IPRO 346 team will present effective methods of public awareness. The team will provide extensive deliverables, such as a project plan, an abstract, a mid--term presentation, and a final report. However, aside from these critical aspects, the IPRO team will be creating posters, PowerPoint presentations, visual aids to present information, like an awareness video, a facebook and a twitter pages. To further extend this IPRO's knowledge a series of meetings with public officials and IIT administrators. To ensure that deadlines are met, each sub--group will regularly provide details and report back to the entire team regarding their accomplishments, research, and progress.



b) Designation of Roles

Project Manager (Raksha Rajagopalan) - The Project Manager is responsible for the coordination of all parts of the project. They should be in regular contact with the Subgroup Leaders and have the overall goals of the project in mind. They will make sure all Subgroups are contributing to the completion of the project in a consistent way.

Minute Taker (Mansi Patel) - Records the discussion during any meetings, paying special attention to the following: decisions made, tasks that require work outside of class for completion, and timelines for all applicable notes.

Agenda Maker (Cheng Li) - Creates an agenda for each meeting to provide structure to the class meetings. Agendas should be emailed to the class by 10pm on the day before any class meeting to allow for idea preparation.

iGroups Moderator (Anthony Ruth) - Is responsible for organizing the team's iGroups account and updating it regularly. They should make sure the Agenda Maker posts the current agenda and the Minute Taker posts meeting minutes in a timely manner.

Subgroup Leaders (Narayan & Mansi) - The team will consist of two subgroups. Each subgroup will have a leader. Each of these leaders will be responsible for coordinating the work of their subgroup.

External Affairs Coordinator (Esther) - The External Affairs is responsible for all communications with outside institutions about the development of this curriculum or about its eventual implementation.

Web Designer (Josh & Rene) - The Web Designer is responsible for the creation and effective use of a website via facebook and twitter. They should determine, with the input of the team, whether or not a separate website is an effective tool. From there, he or she will decide on the appropriate content, organizational scheme, and how to present the material in a simple yet attractive way.

This IPRO team will continue to expand on and evolve educational and public awareness by working to change public policy.

First the IPRO will work on developing plans for a working model that this IPRO and future IPROs can take to meeting with officials. Member of the IPRO worked with the idea shop to build a 3D model.

Second, the IPRO team will focus on the use of social media to promote and spread the message on the use of condensate from air conditioning. And by understanding how people

feel about the use of the condensate we will be able to address those barriers with the data obtained by the IPRO.

Third, the IPRO will work on secure appointments with official from educational institutions and the city of Chicago to identify practical and political barriers to overcome the barriers that do not allow the use of harvesting of condensate from air conditioning and to develop a plan of action.

IPRO 348 will continue to help expand and alter social and educational attitudes on the use of condensate from air conditioning. In order to accomplish this, the team members will draw on their experiences in Illinois Institute of Technology's education. By doing this, the team members can draw on aspects that had worked well, and what aspects hindered progress in order to modify the social attitude with respect to the use of condensate. If successful, it will make the notion of using condensate as natural as opening the tap.

4. Analysis and Finding

The two main goals for the project include building awareness of our ideas, and having a working prototype to demonstrate these ideas. As away to reach out, a Twitter account and Facebook account were created at the beginning of the semester. Information of the project and updates on the team's progress has been posted on both accounts, in hope to spread the word, build awareness of the problem, and spark interest from various communities and people. So far, 125 people befriended the project's Facebook account, and the Twitter account is followed by 6 other accounts; among them is Water PAC, "a political action committee to assure clean water for the world." Using both accounts, we were able to exchange information and opinions with those we would not have been able to encounter normally. A facts sheet has also been constructed with information meant to build awareness of the usage of water in the US, the scarcity of it in other parts of the world, as well as the team's proposed solution to such problems.

To extend our influence and further our reach by notifying the official committees of the city involved in water usage, we have contacted numerous organizations and personals for a chance to present to them the proposal we have prepared. Among them are, Illinois Environmental Protection Agency, Alliance for the Great Lakes, Chicago Metropolitan Agency for Planning, Naperville Park District, Chicago Center for Green Technology, Chicago Department of Environment, American Society of Plumbing Engineers, and IIT director of Campus Energy and Sustainability (CES). By the time of the write-up of this report, we have gotten positive responses from Chicago City Center for Green Technology, City of Chicago Department of Environment, and IIT Campus Energy and Sustainability. A proposal will be sent to the IIT director of CES, and a meeting date has been scheduled with the Department of Environment.

To ensure the meetings with other committees and city officials will be engaging and convincing, a three dimensional model has been designed and produced by the team. Members of the prototype sub-team taught themselves how to use CAD software, and within a week designed and produced the 3D model that demonstrates the system this project and team is aiming for. It shows the cut-section of a commercial building, with plumbing transporting the collected condensate water from the HVAC units to a reservoir on the roof, which is then

distributed to the toilet inside the building, as well as the garden at ground level adjacent to the building.

In order to make the ideas more appealing and build a stronger case when presenting, the team also worked together to produce a short video to demonstrate the ideas behind the project.

While waiting for responses from the school, the team also placed several plants underneath working air conditioning units around campus, accompanied by signs informing passersby that the plants were watered by dripping condensate from the air conditioners, and the team's contact information was visible as well. This triggered interest not only from IIT students, but also other passersby, who took the time to contact the team for inquiries on more information and possible collaboration in the future.

5. Conclusions and Recommendation

The main goal of this project has been to influence public opinion regarding the use of air-conditioner condensate. We sought to accomplish this by creating a working scale model for use as a visual aid during presentations we would schedule, and further by developing and implementing a functional prototype. In the very beginning a part of the team was tasked with the creation and maintenance of both a Twitter and Facebook page which would make all findings public, and facilitate interaction with all interested parties.

It is the conclusion of the team thus far, that there is indeed interest in the subject, but also that scheduling meetings with city officials and interest groups is a difficult and time consuming process. While Twitter has not proven as fruitful as originally expected, our Facebook page has attracted 125 friends in less than eight weeks. It is the opinion of the team that this is a fairly substantial number given the short time the page has been up. This in addition to findings by previous IPRO teams is more than enough to conclude interest is present. During the first few weeks, we both designed and constructed a working model for use as a visual aid during presentations to be given to city officials and interest groups. A short video was also produced in order to better convey our ideas. Our largest difficulty has been actually scheduling meetings with those to whom we wish to present our ideas. A large part of this has been the lack of timely responses to our emails and calls. This is not incredibly surprising, as eight weeks is a fairly short window during which to both decide and then attempt to arrange any sort of meeting with, or presentation to city officials.

While our team was not able to construct and implement a fully functional prototype, we did design and price one. It is the opinion of the team that this prototype be implemented and tested by future IPRO teams. We propose it be implemented and tested somewhere on IIT campus, and used to water flower beds and or grass. It is also the team's opinion that future IPRO teams use the model created this summer to make presentations to interested parties. Should future IPRO teams wish to give presentations, they will need to identify target audiences, contact them, and start scheduling meetings very early on in the term. We recommend the continuation of this project, as we have provided the tools for its success. With our working scale model, existing social networking connections, and practical proposal for a working system; future IPRO teams should be very well equipped to finish what we've started.

6. Appendix

Team Roster:

Name	Major	Email
Kenward, Joshua	Information Technology and Management	jkenward@iit.edu
Li, Cheng	Applied Math	licheng@iit.edu
Natarajan, Narayan	Aerospace & Mechanical Engineering	nnataraj@iit.edu
Patel, Mansi	Molecular Biochemistry and Biophysics	mpatel67@iit.edu
Rajagopalan, Raksha	Chemical Engineering	rrajago6@iit.edu
Romo-Ortiz, Esther	Psychology	eromoort@iit.edu
Ruth, Anthony	Physics	aruth@iit.edu
Tapia, Rene	Information Technology and Management	rtapia@iit.edu

Faculty advisor: Phil Lewis

Budget:

Activity	Cost	Description
Potted Plants	$33.94	Required potted plants to illustrate simple steps towards recycling condensate.
Grass for Model	$10.00	Grown grass to be added to the model representing a garden
Piping for model	$16.88	
Food during meetings	$120.00	6 people * $ 10 * 2 meetings
Transportation	$63.25	CTA passes to attend two meetings (11 passes @ 5.75 each)
Total	**$244.07**	