

April 20, 2005

The Air Quality Impact of Installing Dynamic Air Cleaners and New Temperature Controls at a Riverboat Casino

Executive Summary

This testing was done at a Riverboat Casino in the south. The Casino portion of this facility has three floors of Casino operations; total square footage is approximately 35,000 square feet with an average ceiling height of 9.5 feet. The gaming space is conditioned by 24 air handlers delivering 128,000cfm of air. This airflow results in approximately 24 air changes per hour. The air handlers are located in the ceiling space on each floor. Air is exhausted from the ceiling space which serves as the return air plenum. Outside air comes into each air handler from a fresh air intake louver. The Trane Company was contracted to install Dynamic V-bank Air Cleaners in place of a pre-existing media/charcoal filter arrangement. The system was rebalanced and new controls were put in to control the ventilation air to 15cfm per person air and building pressurization to keep the Casino slightly positive to the outside. The air was tested for one week prior to the installation and one week following using an Aircuity air quality monitor. The tests showed a 32% reduction in large particles, a 7% reduction in small particles and a 63% reduction in total volatile organic compounds (odors). These reductions were achieved while the outdoor levels of small particles increased 109%.

Test Location

Riverboat Casino

This is a Riverboat Casino, fully Coast Guard approved, located on a river in the south, adjacent to the land based lounges, restaurants and a hotel complex.

Filter / Air Cleaner Specifications

Before: High-density media filters and 4" carbon filters in each air handler. Additionally, 26 supplemental air handlers with 85% bag filters and 4" carbon recirculating the air in the Casino.

After: Dynamic V-Bank Electronic Air Cleaners. The supplemental air handlers were turned off.

Test Measurement Equipment

System Monitor – Aircuity Optima System 500. The Aircuity is a comprehensive air quality system monitor that records and downloads data to the Aircuity mainframe computer for plotting and evaluation. Measurements are recorded every minute throughout the sample period for temperature, relative humidity, carbon dioxide, total volatile organic compounds, particle mass <2.5 microns, particle mass <10 microns, carbon monoxide, ozone, and radon.

The Aircuity monitor has been factory maintained and calibrated according to the prescribed schedule.

Testing Methodology

The Aircuity system monitor was placed inside the common return plenum above the ceiling tiles and took automatic readings every minute. The minute readings were averaged into an average/hour reading for charting purposes. The monitor was also moved outside to obtain outside air data before the start of each test.

Test Results

Aircuity System Monitor: The following chart shows average per hour particle reductions after the installation of the Dynamic Super V-Bank Air Cleaners:

Data Averages	Before Dynamic: 12/29/04 - 1/5/05	After Dynamic: 3/30/05 - 4/6/05	% Reduction	Outside Air Before Dynamic: 12/29/04 - 1/5/05	Outside After Dynamic: 3/30/05 - 4/6/05	% Increase In Outside Air After Dynamics
Average Large Particles >2.5microns<10microns	2639	1793	32%	8,254	42,913	420%
Average Small Particles >.3microns <2.5microns	11,817,442	10,985,982	7%	1,672,651	3,503,709	109%
Average TVOC Index	108.2	40.1	63%	8.5	9.3	10%

Dynamic Air Cleaners reduced the concentration of the small air particles, large air particles and volatile organic compounds (VOC's-Odors). The total average indoor air large particle count dropped 32% while the total outdoor average particle count increased 420%. The total average indoor small large particle count dropped 7% while the total average outdoor average particle count increased 109%. The total average indoor TVOC index dropped 63% while the total average TVOC index increased 10%.

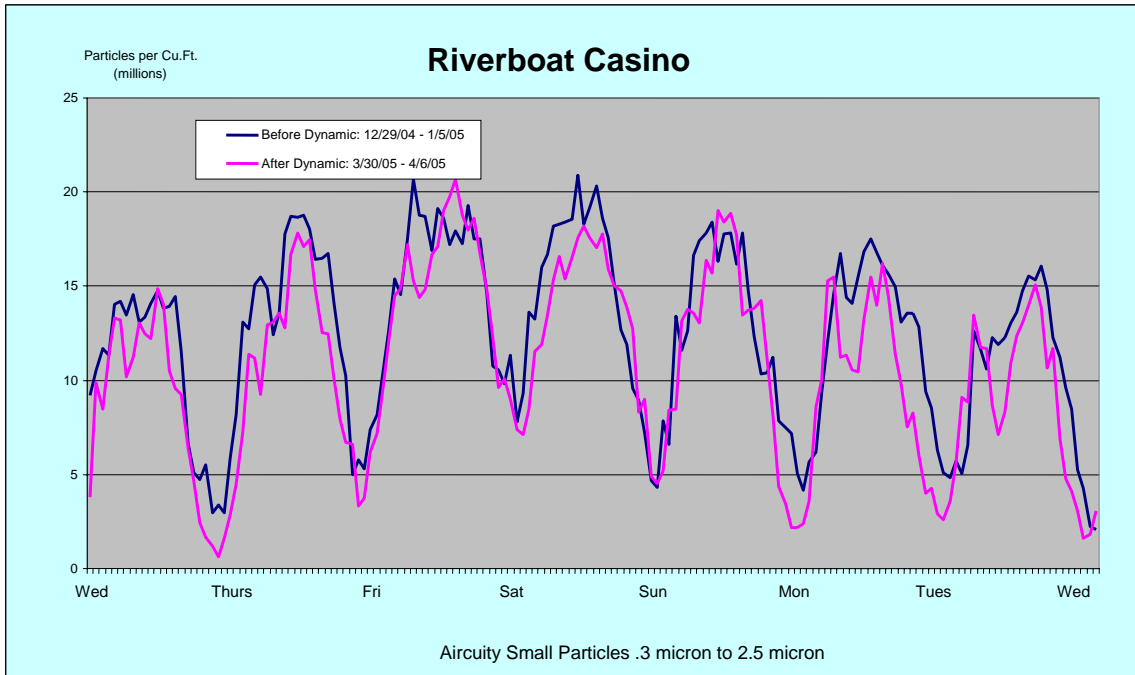
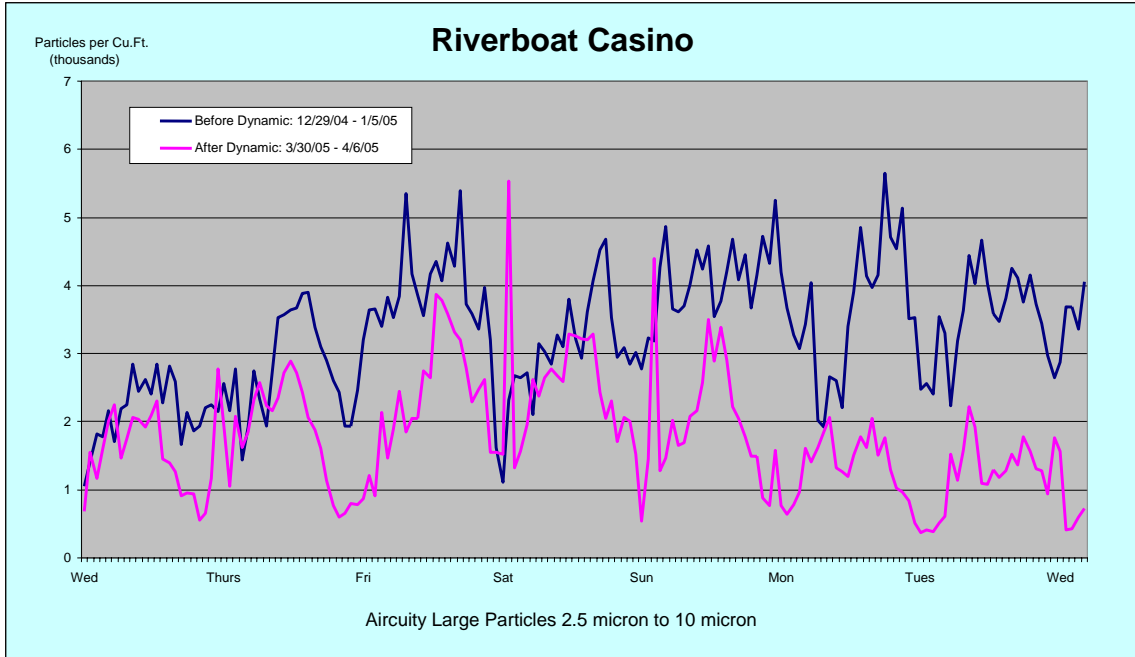
It should be noted that the vast majority of the particle count generated by cigarette smoking is smaller than .3 micron and therefore not “seen” by the particle counter. Typical tobacco smoke is between .01 to .1 microns. One issue with particles in this size range is that they are not easily moved by the air streams—very small particles move in an almost random way and are as impacted by collisions with gas molecules, and ambient

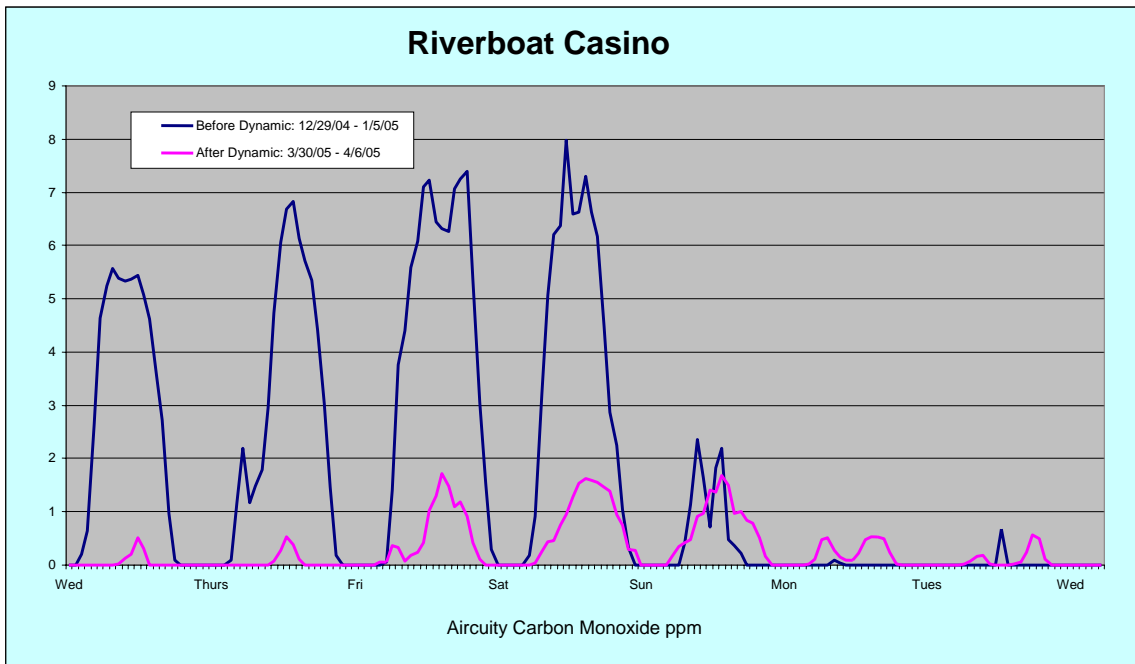
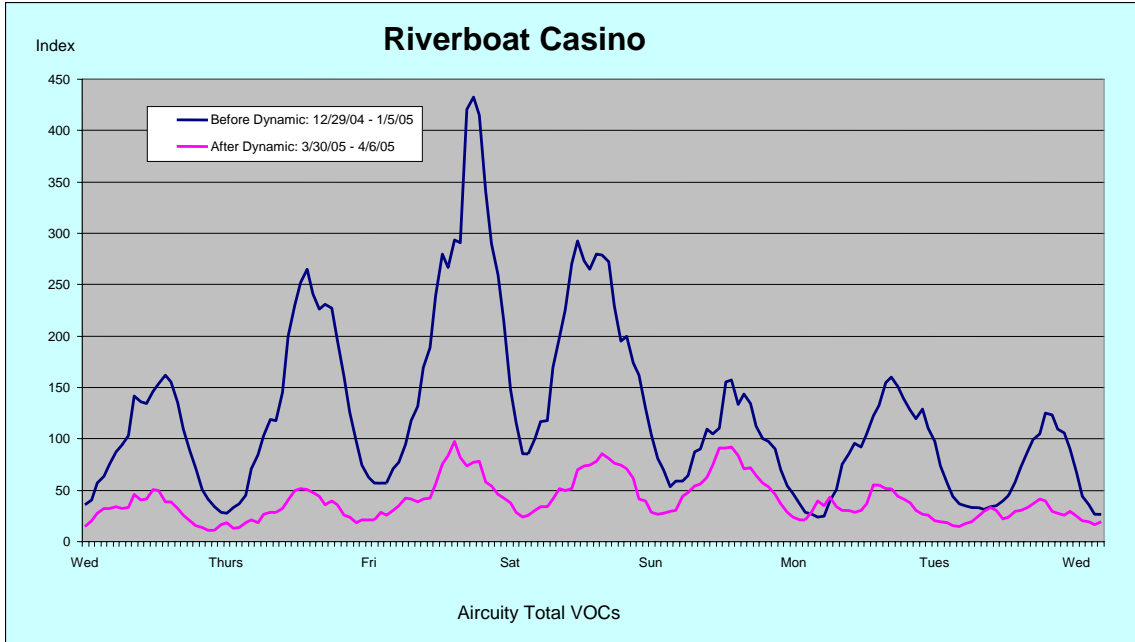
electrostatic and electro-magnetic fields as they are by general air flow. Agglomeration is the natural process whereby particles will come together and form larger groupings. Because of their various mechanisms, Dynamic Air Cleaners greatly accelerate this process and cause the particles to become bigger and more easily captured by the ventilation system and then the air cleaner. The particles will also then be in the size range wherein they can be “seen” by the particle counter. This, coupled with the increase in outdoor small particles, explains why the small particle reduction appears low in comparison to the large particles and TVOC reductions. When adjusted for the increase in outdoor air small particles, the reduction becomes 26%. The large increase in outdoor particles is believed to be due to the spring pine pollens in the air at this time of year.

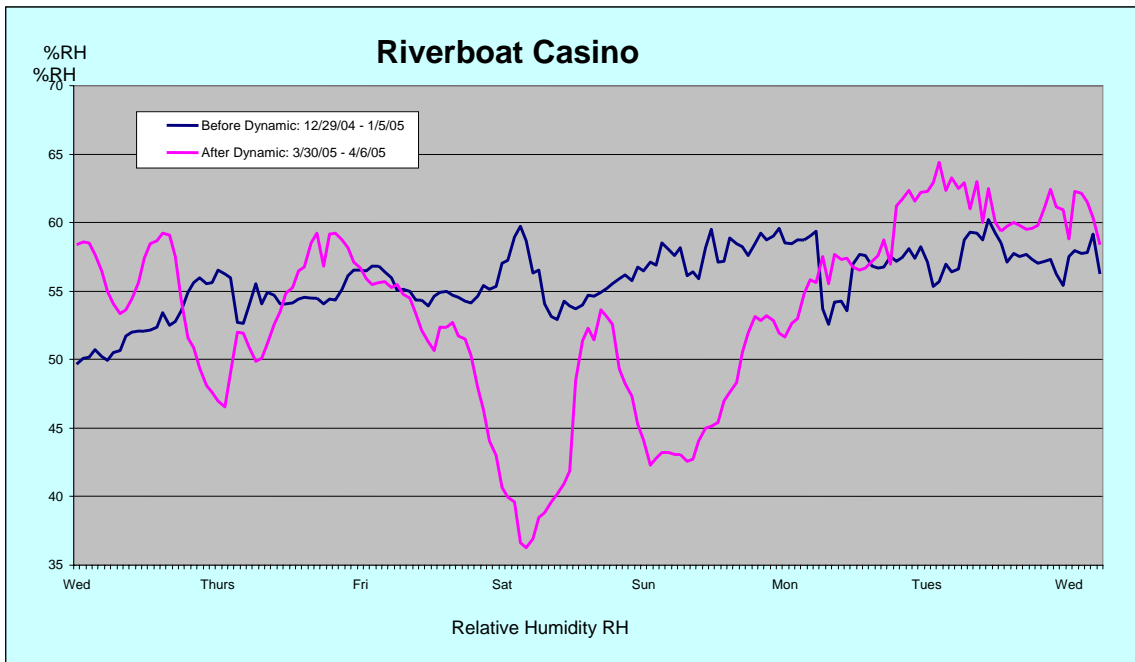
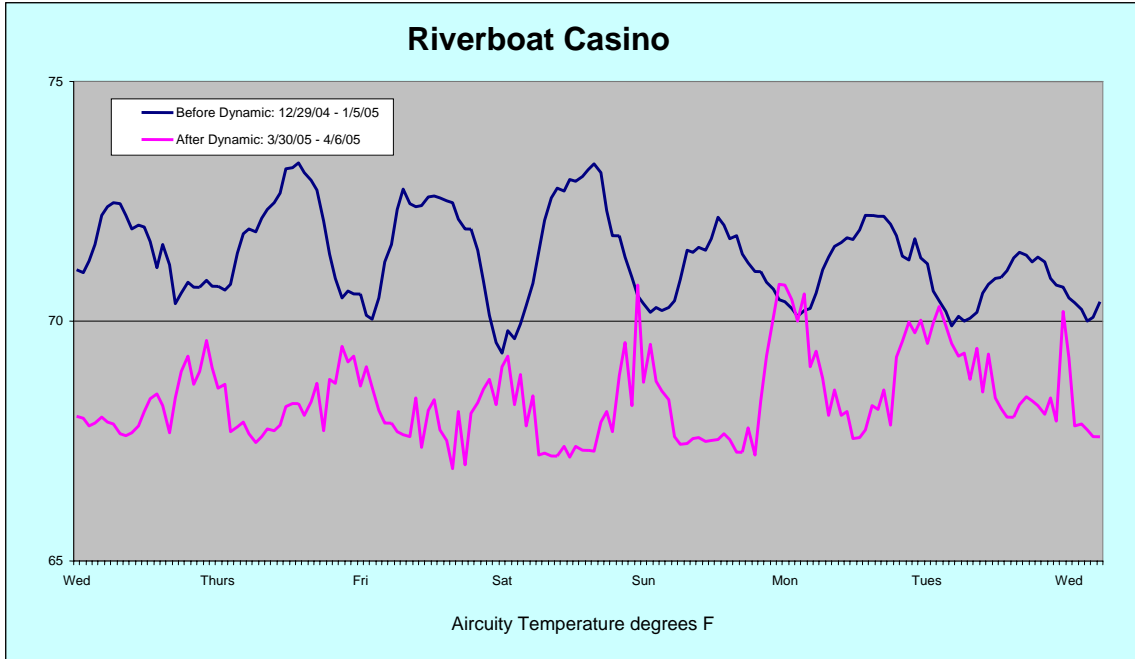
The polarization and agglomeration of the small particles also helps with the dramatic reduction in TVOC’s as these gases are taken out of the air as they are adsorbed and absorbed by the small particles. The graphs for CO₂ and CO show that the new control system is maintaining constant relationship to the number of people in the building with these being leveled out during high occupancy hours. Dynamic Air Cleaners have no effect on these two inert gases. The only way they can be controlled is by dilution with outdoor air.

Cost Savings

Significant replacement media savings will be realized through extended change-out intervals and the lower cost replacement media in the air handlers. The elimination of the supplemental air handlers eliminates the need for replacement media for them, in addition to the reduction in energy consumption as a result of turning off the 1.5 HP fans in these units.







Note: The Aircurity monitor also measures Ozone and Radon however these values were insignificant both in the before and after testing. Raw data files for all above charting is available on request from Environmental Dynamic Group.