Shaw Method of Air Conditioning

The Shaw Method of Air Conditioning (SMAC) system is a new twin-coil system that is the fifth and last of a number of air conditioning innovations developed by the late Dr Allan Shaw, formerly of The University of Adelaide described in his patent. The new technology is the only twin-coil system patented world-wide (US Patent 6269650), using series pipe circuiting to maximize efficiency. It is based on earlier work of the inventor, which employed parallel pipe circuiting. The series system is more efficient, as the same water goes through both coils, halving the pumping energy required.

SMAC differs from conventional air conditioning in that, rather than drawing untreated outside air and then cooling it within the total air system, incoming outside air is pre-treated (dehumidified and cooled) by a separate, purpose-designed dehumidification coil before merging with recirculated return inside air. Outdoor is only a fraction of total air. The outdoor coil receives the coldest water to provide the greatest potential for moisture removal. Temperature within the space is controlled by a separate dry cooling coil through which recirculated return air passes. SMAC prevents the need to use energy twice to overcool and reheat air in order to maintain humidity in the occupied space, and monitors and adjusts humidity levels, providing better control.

Three key components give the system its competitive edge:
• Dual coils separate the process of treating latent loads (typically to remove moisture from outside air) and sensible loads (typically internal air which is dry).
• Series pipe circuiting maximizes the system’s efficiency.
• Controls provide integrated control of humidity, temperature and chiller operation to ensure that air treatment processes optimize energy performance at all times.

The Shaw method is based on integrating three control variables. The process works by multiple feedbacks from three control loops complementing each other to control humidity, air temperature, and the chilled water velocity. While the idea has been around for years and was discussed by the late Allan Shaw in many papers, it wasn’t practical until today’s microprocessors enabled the control sensor technology to become sensitive and reliable enough. Main features of Shaw’s control logic are:
• The leaving water temperature of the chillier can be reset by either the space relative humidity or the coil water velocity via the high signal selector.
• The control set points are programmed so both the humidity controller and the water velocity controller will lower the leaving water set point from 15°C/59°F to 7°C/45°F as either the humidity rises above 60 per cent or the chilled water velocity increases above a nominal 2m/s for all coils in any one zone of a multi-zone air handling unit.
• The temperature controller directly modulates the first stage of the AHU coil, with the water velocity controller only permitting the second stage control valves to modulate whenever the velocity in any coil is above 0.2m/s, ensuring turbulent flow in the coil(s). This is dependent on the space temperature controller modulating the chilled water valves as the zone temperature increases above the set point, nominally 24°C/75°F.
• The leaving water temperature is not reset downwards by the water velocity controller until the entire coil valves are fully open. The control of the three variables is from individual proportional plus integral algorithms, which are tuned to prevent instability.

Experience has shown this engineering and tuning is no more time consuming or difficult than for a conventional system. SMAC is suitable for both new and retrofit systems, and provides control of both sensible and latent loads in an energy-efficient manner, by the dehumidification of outdoor air at a separate coil. It is suitable for a wide range of ambient conditions and for full to part loads, with all system components readily available. Reheating the air is unnecessary.

The twin-coil system builds on existing practices and has minimal impact on other components, while at the same time delivering significant improvements in performance. In short, SMAC reduces energy consumption, with associated reductions in energy cost and greenhouse gas emissions, and with less variation in temperature and humidity levels. SMAC is particularly suitable for art galleries and similar facilities that have a requirement for high humidity limit control. Conventional systems typically ignore humidity as a control requirement and in the process, over power air conditioning with cooling to prevent humidity from becoming a problem. The system is effective in dry climates, as in South Australia, and in high humidity climates, as in Thailand.

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ENERGY EFFICIENT AIR CONDITIONING 2008 Nova Award Nomination 1

Shaw Method of Air Conditioning

Art Gallery of South Australia

City Centre Office Complex

Barmera Hospital

Projects and Savings

Project	Date	Savings	Comments
Citi Centre Office Complex Adelaide	2006	95% heat, 66% fans 60% cooling	Installed to 2 floors retrofit from fan assist VAV to SMAC + Induction VAV. Raised Australia green rating from audit 2.5 to 5++.
Adelaide City Council Colonel Light Centre	2006	Not determined.	Corrected problems with drafts and simultaneous heat and cool between ambients 17 to 28°C. Eliminated simultaneous cooling and heating.
Rolly Tasker Sails, Phuket, Thailand	2006	Over 50% total	Chiller reselected from 280 tonnes to 144 tonnes. Operating over 9 months and chiller not yet fully loaded
Siam Cement Bankok, Thailand	2005	30% total.	Converted sick building to excellent and with 30% energy savings. 900% increase in outside air.
Art Gallery of South Australia	2004	75% heating 58% cooling	Installed to 30% of site. AIRAH and NECA National Awards
Barmera Hospital South Australia	2002	At least 50% cooling	NECA National Award of Excellence Winner