Sheep growers in Victoria's western district are facing a scenario not experienced for many years – shearing shed condensation. As Sean McGowan reports, wet sheep housed in shearing sheds are creating a high-humidity environment that reduces the sheds' ability to dry out and impacts on the productivity of shearing operations.

SHEARING SHED BLUES

Australian farmers can't catch a break – if it's not a 10-year drought affecting water and feed then its record rains washing them out.

Such is the case in regions of western Victoria, where wool growers have experienced a return to the wet winters of decades past. Not only have wet conditions created challenges in maintaining healthy flocks, but it has also affected those who undertake shearing during these times.

For some unfortunate growers, the age-old problem of shearing shed condensation has re-emerged, affecting productivity, wool quality, and in some cases, animal health.

It is a common but not unmanageable problem that is environmentally induced.

According to Mitchell Trickey, project officer for Australian Wool Innovation, there is a combination of variables that expose some farmers more than others.

"Shearing shed condensation is only an issue when you are undertaking shearing in less than ideal conditions, where animals may need to take refuge inside in order to dry or remain fit for shearing," he says.

"Therefore, it can be said that the issue is most commonly found on those farms that undertake shearing in rainfall-dominant winters; however, in rare circumstances the combination of low air temperature and high moisture content may occur outside of the cooler months of the year."

Trickey says it is imperative that sheep are dry before shearing, as wet wool is unsuitable to be pressed into bales. A complex chain of reactions can occur within wet wool that results in irreversible fibre damage, including discolouration and degradation. Furthermore, the shearing of wet animals raises occupational health and safety concerns.

For this reason, he says, shearing sheds are often used as important refuges for animals pre- and post-shearing.

"Penned sheep may be placed in sheds to avoid adverse conditions," he says. "Or, less-favourably, previously wet sheep may be stored overnight in the shearing sheds in an attempt to dry the animals – provided that an appropriately low-storage density is observed."

Trickey says the number of sheep stored should be proportional to the area (sq m) and the functional role of the storage area at the time, with consideration given to the density's impact on thermal energy output such as respiration and body heat.

For example, in a catching pen prior to shearing, sheep can be contained at up to 3-3.3 sheep/sq m.

"By comparison, overnight storage of pregnant ewes might be around 1.5 to 2 sheep/sq m and drying out wet sheep could be as low as 1/sq m," he says. "If animals are wet, increased heat will further raise the relative humidity of the environment increasing the chance for problematic condensation to develop (within the shed)."

Australian shearing sheds naturally differ in size – commonly expressed in "stands" (the number of shearing machines available for the shearer/s to use to shear the sheep) – with the majority containing between two and six stands. Exterior, under-roof dimensions range from 20m x 10m to 40m x 20m.

A number of substantially larger shearing sheds exist, but are not as common.

The buildings are typically constructed using a steel or timber frame with corrugated iron sheeting. Common flooring materials used in the wool harvesting and working areas are timber and concrete, while sheep-holding areas are usually floored, with timber grating featuring 12–15mm gaps between battens to allow aggress of dung and urine.

A TECHNICAL RESPONSE

The issue of condensation has existed for as long as the Australian wool industry has been shedding sheep for shearing. Yet relatively effective abatement measures have been established by many in the industry, with ventilation being among the easiest and most obvious method of eliminating condensation.

Many farms have used ceiling fans, roof-ridge ventilation and well distributed gaps in wall cladding. But cold drafts must be avoided, as cold temperatures can be detrimental to the animal health of recently shorn sheep, especially if wet.

Trickey says foil-backed sarking and sisalation has also been adopted by shearing shed manufacturers and builders as best practice in reducing shed condensation. This practice also improves the building's radiative and conductive properties – as has the use of bubble wrap and fibrous materials to further insulate.

Yet for many farmers in rainfall-dominant winter districts such as those experienced in western Victoria, the problem continues to exist.

Their frustrations resulted in Trickey recently contacting AIRAH in search of a technical solution. It resulted in some interesting responses offered by AIRAH members.

Among them was Paul Graham, M.AIRAH, who, despite declaring to not be an authority on the topic, has a brother who farms sheep in southern New South Wales and is therefore at least familiar with practices.

According to Graham, senior mechanical engineer at ALA Consulting Engineers, the issue of condensation is particular to the climate, construction and building fabric, level of insulation and the degree of infiltration.

"It may be that in newer and better sealed sheds there is inadequate ventilation to maintain the internal air dew point below the internal surface temperatures, which would cause condensation," he says. "But this is just a guess and would need investigation."

He suggests that among a few possible solutions is to provide a minimum level of insulation matched to the expected internal dew point given a shed loaded to maximum capacity on the coldest night. He says the internal dew point will take account for the expected ventilation rate.

Other suggestions include maintaining ventilation openings, corrosion protection for any components of the shed affected by internal condensation, the minimisation of cold bridging between external sheeting and internal components and the management of condensation to drip or collect away from the sheep.

"Mechanical ventilation is a last resort due to capital cost," Graham says. "Heating also would be an unlikely option due to capital and running costs and the practicality of getting energy supply to the shed, which may be quite remote."

Another keen respondent was Dr Richard Aynsley, F.AIRAH, former director with Big Ass Fans and now consultant with Building Energetics. He says nocturnal condensation on the upper and lower surfaces of corrugated steel roofing is a very common occurrence in Australia, and is covered in some detail by AS1562.1.

Having presented a paper for AIRAH on the subject of condensation, he says it is often the result of poorly designed buildings and inappropriate use of materials, which can result in mould, wood rot and electrical safety issues.

In the case of shearing sheds he recommends the use of sarking to drain condensation down to the eaves and reduce radiant heat gain.

"Most sarking in roofs serves both moisture and radiant heat-control functions," Aynsley says.

"Sarking typically has aluminium foil surfaces that when facing an air space creates a radiant barrier, and this prevents approximately 97 per cent of radiant heat entering the space below. Radiant heat can be a major source of heat gain to building occupants under exposed metal roofing if the temperature of the roofing exceeds indoor air temperature by more than 4°C."

The timber grating floor of a shearing shed.

Similar condensation issues apparently exist with chicken sheds in Western Australia, of which Charles Rendigs, business development manager of Thermoshield, shared his experiences.

"In either case, whether it be sheep or chickens, the body heat from the animals coupled with respiration increases temperature, which in turn comes in contact with a cold roof," Rendigs says. "You have warm air rising coming into the shed, via animals, that has no sisalation and as a result condensation takes place."

He says because older building regulations did not require sisalation, it may be a case of ensuring old existing shearing sheds are well ventilated from the top and bottom to create a circular air flow. He says adequate insulation must be applied to the inside of the shed so that the metal doesn't get as cold.

"So what you have is hot air coming in contact with a moderately warm substrate, and in turn minimising the amount of condensation taking place," he says.

"It's all about systems, and they need to be designed to be complementary. It's not just about throwing big and costly mechanicals at the problem, but actually minimising their need."

SEPARATE ISSUES

According to Martin Bruekers, M.AIRAH, senior technical officer for the Northern Territory's Department of Lands, Planning and Environment, the dampness of wool before shedding and the issue of condensation in the shed should be considered separately.

"My speculative thoughts are that the cause may be warm moist air trapped within the wool coming into contact with cold ambient conditions, causing condensation within the wool," says Bruekers, who serves on AIRAH's Northern Territory division committee.

Because issues of condensation and humidity are endemic to the tropical built environment of the Darwin region, he says condensation is usually managed effectively with air movement, even at high humidity.

However, having been raised in Western Australia's sheep and wheat belt, Bruekers believes a brief study on sheep physiology, thermoregulation and habits would result in the source of the problem being accurately identified. A financial impact assessment could then be conducted so that capitalisation limits can be placed on proposed solutions.

"Most solutions for buildings with low utilisation are difficult to justify," he says. "Low-cost, low-tech options like fans are likely to be viable. If there are a range of solutions then the economic analysis would determine the most appropriate option and investment.

"I must stress that the specific cause must be found. The solution is usually self-evident."

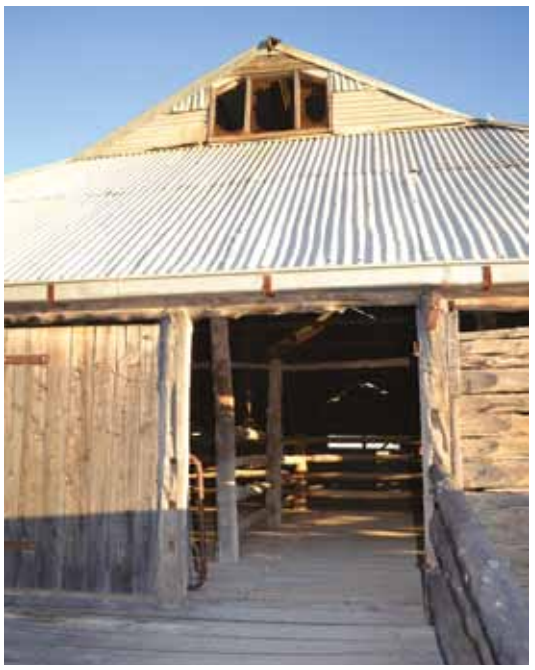
Where a mechanical solution is justifiable, utilising heat recovery to provide dry tempered outside air may be an option according to Shane Carmichael, M.AIRAH, New South Wales state manager at Air Change.

Although it has no direct experience with the problem of condensation in shearing sheds, he says the company has developed solutions for two similar applications: indoor pools and new apartments experiencing moisture build-up causing damp and mould.

In both instances, heat recovery to provide dry tempered outside air has been used, while exhausting the moist air from inside.

There are two major aspects to condensation control: internal surface temperatures and the internal air dew point. Carmichael says a simple way to look at controlled condensation is to keep all internal surfaces warm while reducing the dew point of the internal air by keeping humidity low.

"Insulation and thermal barriers to stop tracking should be used to ensure the temperature of solid surfaces stays as high above the dew point of the air as possible," he says. "The humidity of the air can also be reduced with a dedicated dehumidifier; however, in dry climates such as western Victoria it is easier to simply use tempered fresh dry air from outside, via a heat recovery system, and exhaust the moist internal air.



"Better insulation would be the first step to addressing this problem. However, it is important not to neglect the air side of the equation."

FINDING A SOLUTION

As wet sheep result in considerable losses to wool growers, the financial implication across an entire region, and the Australian wool market, is significant.

Consider, for instance, the losses from degraded wool, the idle contracted labour costs of shearers, wool classers and shearing board staff such as wool-handlers, and the lagged market access due to shearing delays. Additionally, delayed animal husbandry operations, including health treatments, can impact on productivity and structural damage to sheds through rusting.

Multiply these costs across a region's many farmers and it's easy to see why Australian Wool Innovation is seeking a design solution to the pressing problem of shearing shed condensation.

If you have a solution to offer, please let HVAC&R Nation know. If you'll pardon the pun, we are keen to see this great yarn through to its conclusion. ▲

Something to offer?

If you have information to share, write to HVAC&R Nation managing editor Neil Cox at neil@airah.org.au