Submissions to '*A Code of Practice for the Control of Bed Bug Infestations in Australia, Draft 4th Edition*', Mar 2013

1. From: David Loughlin, Sentomol Ltd, 11/Oct/2011:

"In your website featuring the draft Code of practice for the Control of Bed Bug Infestations in Australia, you invite comment on the draft before finalisation. I hope my email arrives in good time.

Firstly I would like to congratulate you on the excellent work you have made on this. In my 25+ years in the industry it is a rare to have one insect cause such a reaction in the industry and there has been a clear need for authoritative sources of information. I feel it is important however that these sources are comprehensive. My question may not be well received, but I was recently talking with Rob Fryatt in relation to Cryonite. It seems Freezing has a mixed coverage in the new set of CoP documents - US, Europe & Australia, with the US reflecting its use more strongly than the other two I would have thought as an IPM tool, freezing would at least have the same coverage as steam and yet appears overlooked in the Australian version and lightly covered in the European version. Strange considering several companies have invested heavily in the product and use it as a valid part of their IPM armoury against bed bugs. Have I missed the references within the CoP?

As you know no product is perfect but in this era of concern for pesticide residues especially in sensitive areas such as schools, hospitals and hospitality, a product approach which leaves no pesticide residue I would argue has a valid place in the market. I recently attended a presentation by Robert Kunst, President at Fischer Environmental Services, at the FAOPMA meeting in India and in his presentation on IPM in Hospitals he was very supportive of Cryonite in this sensitive environment. He is not alone in these views and I am gathering other similar supportive testimonials.

The American Academy of Entomological Sciences has recently conducted some field trials on Cryonite and found it to perform well against bed bugs and cockroaches in a variety of situations, leading to elimination without the use of other control products. I am helping to pull together the data in readiness for publication.

I have contacted the Bed Bug Foundation on this same topic and hope to be able to exchange some views with you on your position on the technology with the hope that it is fairly represented in the relative CoP's."

Some testimonials on the use of the Cryonite were supplied. No report from the American Academy of Entomological Sciences was provided. Since the original submission by Mr Loughlin, an article on the use of Cryonite appeared in

International Pest Control (2012, July/Aug:196-198).

Response from the Australian BB CoP WP.

[***Note: In this and subsequent emails, David Loughlin failed to declare his conflict of interest; we have been reliably informed by two sperate parties that he is a paid consultant for Silvandersson, the manufacturer of Cryonite***.]

Dear Sir, thank you for your email and the compliments for the Australian Bed Bug Code of Practice (CoP). In contrast to your statement above, freezing has been well promoted as a bed bug management option within the CoP. Even the very first version of the CoP in 2006 promoted the killing of bed bugs by cold (Doggett 2006), and this section has been enhanced over time with scientific developments and the appearance of peer reviewed publications (Doggett 2011). In light of the inference (and paid consultancy), the concern by Mr Loughlin presumably relates to the lack of any recommendation for the Cryonite within the CoP.

As a background, if a product has not been mentioned within the CoP, this does not mean that it has not been considered. Rather that that the device or product has probably been considered but the efficacy data is lacking, of a questionable nature, not scientifically independent or valid, or testing has been undertaken by the CoP Working Party (WP) themselves and have deemed the product inappropriate for bed bug management. Thus a product must earn its place to be specifically recommended within the CoP, as we wish to promote the good and exclude the bad. It is now specifically stated within the CoP that "*The use of any management device not specifically mentioned in this CoP is at your own and your client's risk*".

The WP has some years previously reviewed the test data supplied by the company and independently evaluated the Cyronite. The conclusion reached was ***that the Cryonite has no place in bed bug management***. The following discusses this decision.

1. Review of Test Data Supplied by the Company.

a) Laboratory Trial

A laboratory trial (which incidentally is an unsigned therefore endorsed copy by the testing facility) is available at: www.cryonite.net/images/stories/pdf/i2l_cryonite_bedbug_lab.pdf

In summary, 30 adult bed bugs, 30 nymphs (instar not stated) and an

unspecified number of eggs were placed into a small plastic tank, which was treated with the Cryonite. All nymphs died, no eggs hatched, while adult mortality was 96.7%.

WP Comment: in such a small area of treatment (the tank was 33[l]x21[w]x21[h] cm), it seems somewhat surprising that 100% mortality was not achieved. However, this level of mortality would be acceptable for product registration by most government insecticide regulatory authorities.

Yet what does this trial tell us? The reality is that very few definitive conclusions can be made. For example, it would be possible to kill 100% of the bed bugs in the tank by squashing them with a brick, but of course this is simply not a practical option in the real world. Thus while the laboratory trial is the first step in the evaluation of a device, it does not necessary provide a final answer to how the device would perform in the field situation (*conversely, if a product performs badly in a laboratory test, then we can almost certainly expect failure in the field situation*).

b) Field Trial

A field trial (which incidentally is also not endorsed by the testing facility) is available at:
http://www.cryonite.net/images/stories/pdf/i2l_cryonite_bedbug_hotel.pdf

In summary, a hotel room that was infested with bed bugs underwent a combined treatment with the Cryonite and Diatomaceous Earth Dust (DED). Each item found infested underwent two passes with the Cryonite. All cracks and crevices with bed bugs were treated with DED. An inspection one and seven days after the treatment found no living bed bugs.

WP Comment: during the initial inspection, a total of 31 bed bugs (17 adults and 14 nymphs) were detected, which indicates that this was a relatively minor infestation. Ambient temperatures within the hotel room were not recorded. We can only assume that this would have been around 22^{o}C, as this is the temperature by which most thermostats are set to in commercial accommodation facilities. If this was the temperature, then there is a major flaw in the experimental protocol. At 22^{o}C *Cimex lectularius* eggs take on average 13.2 days to develop (Usinger 1966) and thus inspecting at only 7 days means that efficacy evaluation could not be adequately undertaken as eggs may yet hatch. *Thus it is not possible to state that control was achieved in this trial.*

Despite the flawed experimental protocol, there is even a more serious issue in that the trial was unable to determine the relative contributing efficacy of the Cryonite compared with the DED.

To examine this issue further, consider the following hypothetical example in the Table below. In this situation there are two management technologies being employed; Device A and Device B (these could be insecticides or non-chemical means of control; for the purposes of this example it does not matter) against some pest (again, it does not matter which pest).

	Device A	Device B	% Control
Scenario 1	100	0	**100**
Scenario 2	0	100	**100**
Scenario 3	50	50	**100**

If both devices were employed simultaneously within the treatment program and 100% control was achieved, then all the following scenarios are possible. In Scenario 1, Device A killed all the pests but Device B did nothing. In Scenario 2, Device B killed all the pests, and Device A did nothing. In Scenario 3, both Devices contributed to achieve a 100% kill. However, what the Pest Manager observed was only the final result, namely that complete control was achieved. Thus by using more than one technology within a management program, **it is impossible to determine which (or how much) each is contributing to the control program**. Sadly we often see situations where Pest Managers believe a device is working but in fact it may be doing very little (*and sadly some less scrupulous companies rely on this fact*). The reality is if you gathered the best 100 pest control companies in the world, had them treat a room with two devices simultaneously and then asked them how much each device contributed to the control program, not one of them could answer this with any degree of certainty. Thus company testimonials must be treated with a certain amount of scepticism.

With respect to the field trial mentioned above, it is known that DED is highly efficacious against bed bugs (Doggett & Russell 2008) and complete control could have been achieved with DED even if used alone (note the images in the above report indicate that the insecticide dust was very heavily applied). Thus it may be possible that the Cryonite contributed very little in the control of the infestation (that is if it was controlled, see above comment); we shall never know as it is impossible to determine from the trial the contributing efficacy of this device.

Thus the trial data supplied by the company are open to other interpretations, which meant that the information provided could not be used to justify the inclusion of the Cryonite into the CoP. However, despite the poor trial data, the WP was willing to undertake testing of the Cryonite themselves and did so in 2007.

Before the test results by the WP are presented, anyone who is considering incorporating any new management technology into their control program must ask themselves several questions before actually using the product, such as; *is the product conceptually sound?*, *is the product conceptually flawed?*, *is the product conceptually weak?*, etc. For example, all insects will succumb to heat, and so heating items for bed bug control is conceptually sound (of course how it is implemented can be the flaw), the use of older generation pyrethroids such as permethrin for the control of modern fields strains is conceptually flawed due to the high level of insecticide resistance. How does the Cryonite fit into this scenario; does it appear conceptually sound, flawed or weak, or perhaps even operationally flawed?

To answer this, it is helpful to consider an alternative technology but one which utilises gas; i.e. steam. Steam has come to be widely employed in bed bug management; however training in the use of this technology is essential, both from the point of optimizing control efforts *but also to minimise the risk of blowing bed bugs about non-lethally and thereby potentially spreading the infestation.*

In the following video, http://medent.usyd.edu.au/bedbug/videos/steam1.wmv, a steam machine is being used in an attempt to kill one adult male *Cimex lectularius* bed bug. The steam machine has a single jet head fitted and was set to the minimum flow rate. What is obvious is that the bed bug is blown away by the jet and it takes three attempts before the insect is finally killed. Thus bed bugs can be blown away by the steam head without being lethal to the insect.

As the non-lethal spreading of bed bugs is a recognised problem with single jet steam heads, it is now recommended within the CoP (and by others) that a multiple jet head be used. In the following video, http://medent.usyd.edu.au/bedbug/videos/steam2.wmv, a multiple jet head (again the machine is set to minimum flow rate) is passed over a series of adult *Cimex lectularius* bed bugs. All are killed and none are blown away (some of the dead bed bugs have stuck to the wet steam head but are all dead).

So what is happening with the single jet steam head? For the steam jet to reach its target, it must displace an equivalent amount of air and thus a wave of air at ambient temperature is pushed ahead of the steam jet. It is this ambient temperature wave of air that results in the bed bug being blown away without being killed. Of course this is just

one bed bug, just imagine a more normal infestation such as the one depicted in the picture on the previous page, where there are cast skins and a range of bed bug stages. It is quite typical for young nymphal bed bugs to harbour in or on the skins of later stage nymphs. In fact it is known that mild air currents and even static electricity can disperse bed bugs (Feldlaufer and Loudon 2011). In a very important and relevant paper to the discussions herein, published by the US Department of Agriculture, "*Undesirable dispersal of eggs and early-stage nymphs of the bed bug (Hemiptera: Cimicidae) by static electricity and air currents*", the authors Mark Feldaufer and Catherine Loudon describe their observations in how bed bugs can be very readily dispersed by air currents, which is an observation seen by others (including at the Department of Medical Entomology, Westmead Hospital). The exuviae (cast skins) of bed bugs are extremely light and are readily disturbed and blown elsewhere, with the juvenile stages sitting in the exuviae, thus even a slight air current can result in the spread of a bed bug infestation.

Now consider the Cryonite; this unit can only be set to one flow rate otherwise the snow will not form, and the flow rate is many, many times more powerful than a single jet steam head (as per image below). While the flow rate has not been measured it is quite substantial.

Like with steam, for the jet of Carbon dioxide from the Cyronite to reach the target, an equivalent amount of air must be displaced and a wave of ambient

temperature air will be pushed ahead of the carbon dioxide steam. In light of the result with a single steam jet head and the fact that the jet steam is much many times more powerful, it would thus appear that the Cryonite is operationally flawed. However, it is still important that it is tested, which (as stated above) the member of the WP did so and the results are depicted in the following videos.

In the first video, http://medent.usyd.edu.au/bedbug/videos/cryonite1.wmv, five adult *Cimex lectularius* bed bugs where placed onto a white board and the Cryonite steam was passed over them. All five bed bugs were blown away and all survived (two were blown across the room and found approximately five metres away). In the second video, bed bugs on a mattress were being treated; http://medent.usyd.edu.au/bedbug/videos/cryonite2.wmv (these were again adult *Cimex lectularius*). Three of the bugs were killed, while three were blown away without being killed, again these were blown away some distance. If this was a field infestation with different stages of bed bugs and cast skins (as per image above), then the infestation could have been widely spread, making ultimate control more challenging.

There are two reasons for non-inclusion of the Cyronite system within the CoP;
1. The poor quality of the efficacy data.
2. The high pressure of the Cryonite system can dislodge bed bugs uncontrollably and non-lethally blow the insects away and thus has the potential to increase the risk of treatment failure.

Regarding the “American Academy of Entomological Sciences”, this is a privately run testing facility (http://www.entomologyacademy.com/) with no publications identified to date in peer reviewed journals on bed bug management, which does undermine their credibility in this area. The article on the use of the Cryonite against bed bugs in *International Pest Control* was authored by Mr Loughlin and the above paid consulting organisation, and thus does not represent independent research. *International Pest Control* is not a peer-reviewed journal and the article would not pass the scrutiny of a quality scientific periodical.

References

Doggett, S. L., and R. C. Russell. 2008. The resurgence of bed bugs, *Cimex* spp. (Hemiptera: Cimicidae) in Australia: experiences from down under. p. 407-425. *In* W.H. Robinson, and D. Bajomi (ed). Proceedings of the 6th International Conference on Urban Pests. Budapest, Hungary.

Feldlaufer, M. F., and C. Loudon. 2011. Undesirable dispersal of eggs and early stage nymphs of the bed bug (Hemiptera: Cimicidae) by static electricity and air currents. J. Entomol. Sci. **46**:169-170.

Usinger, R.L. 1966. Monograph of Cimicidae. Thomas Say Foundation, Maryland.

2. From Mike Jones, no affiliation listed, 21/Oct/2011:

"I was reading through your 4th draft and came across this mention" The 'Climbup Interceptor' (www.insect-interceptor.com, Figures 15 & 16) is a barrier that has been demonstrated efficacious in a scientific study as part of an IPM program (Wang et al. 2009)." This is on page 43 of your draft.

Changlu Wang is a named person on the invention of the Climb-Up interceptor and unfortunately does not disclose this fact to the public or peers.

See attachment "Detect...sooner" as this was his presentation from the Bed Bug Central 2011 get together. No disclosure, sketchy 'scientific' tests. Is it common practice to have conclusions with tests done with numerous variables?

When a researcher has a commercial interest in a product, with no disclosure, one must seriously consider if the report is fact or simply a shameless plug."

Copies of patent applications were included, which names Dr Changlu Wang as a co-inventor, as well as a presentation from the recent bed bug summit in Chicago.

Response from the Australian BB CoP WP.

[***Note: Despite an email request, Mr Jones failed to disclose his affiliation. There is a Mike Jones who does sell a competing product, namely an unproven (and not stated) bed bug detector from the USA (unproven in that the device has not gone through independent testing and subsequent peer reviewed publication) at www.bedbuginvaders.com. If this is not you then our apologies and we will remove this sentence].***

Mike Jones does have a point; rules of propriety dictate that any relevant affiliations should always be declared in publications or presentations. This does not appear in the attached presentation (nor was not done verbally at the Chicago meeting; in fact an audience member pointed this out to the speaker and conference organisers). As for the "sketchy scientific tests", this is a presentation comparing various detection methods not a rigorous scientific paper so such a judgement cannot be made from this document alone.

In fact the WP has known of this conflict of interest for some time and reviewed the decision to include the Climbup Interceptor (CU) in the 3rd edition of the CoP. The CU has undergone field evaluation and the results have been published in scientific peer reviewed journals (Wang *et al*. 2009, 2010). While the senior author of these papers is Dr Wang, the various co-authors have no commercial interest in the product and include some of the most widely respected urban pest

researchers and pest managers in the USA. Also, the CU is nothing more than a 'pitfall' trap, which is a device in common use in experimental entomology. As the CU has become widely used, it falls into the category of 'common usage' for inclusion in the CoP. With the review of the CU, the WP felt that there was no strong reason why it should be excluded from the CoP.

If you (Mike Jones) do have access to independent peer reviewed publications that demonstrates otherwise, we would be happy to review this data.

References

Wang, C., T. Gibb, and G. W. Bennett. 2009. Evaluation of two least toxic integrated pest management programs for managing bed bugs (Heteroptera: Cimicidae) with discussion of a bed bug intercepting device. J. Med. Entomol. **46**:566-571

Wang, C. L., W-T. Tsai; R. Cooper, and J. White. 2011. Effectiveness of bed bug monitors for detecting and trapping bed bugs in apartments. J. Econ. Entomol. **104**:274-278.

3. From David Priddy, Sundew, 24/Oct/2011:

"All three of our current new entries to the market place MaxumPRO 125 SC (Betacyfluthrin), DeltaPRO 25 SC (Deltamethrin), and (most importantly) BattleaxePRO Professional Crack and Crevice Aerosol (Propoxur, Tetramethrin and PBO) carry registrations for Bed Bugs. I've fielded dozens of calls since we launched BattleaxePRO back into the market place in June of this year saying that BattleaxePRO was their first choice for bed bug knockdown when the pest is first seen or there's an outbreak.

So I guess my questions are:

1. Do our three products gain a mention in the code of practice?
2. If they don't have a mention, what actions do I need to undertake to correct this for this edition?

Please advise how we can contribute to make this edition of the Code of Practice the winning success that it already is."

Response from the Australian BB CoP WP.

Insecticide products are reviewed during revisions of the CoP. If a product is listed as being registered for bed bug control under PUBCRIS on the Australian Pesticides and Veterinary Medicines Authority web site (www.apvma.gov.au) then it will be listed within the CoP. Similarly, those products no longer listed within PUBCRIS will be removed from the CoP.

4. From Lou Sorkin, New York American Museum of Natural History, mentioned to Stephen Doggett at the North American Bed Bug Summit, Chicago 22/ Sep/2011.

“In the CoP it is stated that bed bugs are wingless, this is not the case”

Response from the Australian BB CoP WP.

Lou Sorkin is technically correct on this, the wings of the Cimicidae have evolved such that they are now wing buds, however the insects themselves appear wingless. The text has been modified to state that the insects appear wingless.