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Effectiveness of Kleanup Surfactant on Cleaning Mud and Dags from Feedlot Cattle Using Stocksprayz Cattle Washing Equipment

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Abstract

The Australian Feedlot Industry has a one-time capacity to feed 1.25 million head of cattle with a production value of approximately $2.7 billion annually. The feedlot industry is an integral part of the Australian beef industry, producing high quality grain fed beef for both the local and overseas markets. Like most industries within the agriculture sector, lot feeding is a margin based value-adding business which requires innovative and emerging science and technologies in order to continually improve and remain profitable.

The presence of mud and dags on cattle hides is a major problem to the feedlot and meat processing sectors due to concerns regarding the welfare and health of animals, worker safety issues associated with current removal approaches, increased costs associated with the cleaning and processing of muddy/daggy cattle, and the potential to compromise food safety through carcase contamination during processing.

Many different methods of mud and dag removal have been identified and trialled over the past twenty years. Current solutions fall into three main categories

1. mechanical removal (includes shearing and hand raking),
2. chemical removal (includes soaking with water, washing with high pressure water and the use of detergents), and
3. various combinations of the two approaches.

Stocksprayz Limited has developed a chemical solution Kleanup, application and washing technology that has been demonstrated to be effective on sheep and cattle, and is currently being used at both abattoirs and on-farm feedlots in New Zealand.

This project will focus on examining the performance of this technology under New Zealand conditions through installation and trial of the technologies at Wakanui Feedlot (Five Star Ltd), Ashburton, New Zealand. The final outcomes and conclusions will be used to determine the next phase in the potential approval, registration and adoption of this technology in the Australian lot feeding and processing sectors.

Executive summary

Cattle finished in feedlots with a predominantly winter rainfall pattern in Australia are seasonally exposed to the presence of excessive amounts of mud and dags on their hides prior to processing at an abattoir. This issue has significant additional cost implications throughout the supply chain in presenting cattle for slaughter that are acceptable in terms of hide cleanliness. Under the current operational and management practices used throughout industry, there is additional health and safety risks attached to some methods of cleaning cattle hides prior to slaughter. Industry is seeking through this research project to validate alternative technology that may lead to an improvement in health and safety of workers in the industry, cost savings in preparing feedlot cattle for processing, improved presentation of cattle at the abattoir and an improvement in beef eating quality outcomes for cattle with excessive mud and dags on their hides presenting at the abattoir.

The trial was unable to be conducted using typical grain fed cattle in Australia due to the limitations on the use of the surfactant technology within in Australia. However due to the significance of the issue within the beef supply chain, the trial was conducted overseas to gauge the effectiveness of this particular cattle washing technology and technique.

The cattle washing trial on three groups of cattle from differing feed regimes conducted at Wakanui Feedlot near Ashburton in the South Island of New Zealand tested the effectiveness of Kleanup surfactant and Stocksprayz application equipment.

The trial was conducted over two days under typical New Zealand weather conditions for September, with feedlot cattle displaying moderate to heavy faecal dag loads combined with varying degrees of loose, muddy material on their wintery coats.

The trial cattle were assessed using the Australian Muddy Cattle Assessment Key and supportive photographs of each individual animal. Cattle were cleaned using a temporary cattle wash installed in an existing cattle lane within the feedlot complex.

The subjective comparative assessments indicated a marked improvement in the reduction of loose material and mud from nearly all cattle washed during the trial. This was supported by the photographic comparisons taken at the same time as the assessments. The degree of faecal dags existing on the coats of cattle did not seem to influence the ability of the cleaning process to improve the overall hide condition.

The faecal dags were not significantly reduced during the cleaning process, particularly the larger, more long-term dags adhering to the coats of cattle. However, smaller and presumably less hardened dags were removed, reduced in size or reduced to a softer material during the cleaning process.

The hide area between large, hardened dags was cleaned significantly, particularly along the cutting lines from the brisket area, through the underbelly to the cod/udder area, and on the underside flank areas. The twist area also seemed to be cleaner after washing on most cattle. The hides generally appeared cleaner between the dags, even despite the extensive winter hair length on most cattle in the trial.

The washing process is almost entirely stress-free for the cattle. As the system uses a rotating series of jets propelling solution at moderately low pressure on to the undercarriage of cattle for two

distinct periods of firstly thirty seconds (wash), followed by a second session of three to four minutes' duration (rinse), cattle are not exposed to the procedure for long periods.

The Kleanup surfactant could have valid application in the Australian cattle lot feeding sector in washing cattle immediately prior to slaughter. Kleanup is beneficial in removing mud and loose material from the hide of dirty cattle exiting the wet winter months using only moderate amounts of water, with minimal hair loss, low stress on the cattle and at an estimated cost (under New Zealand feedlot conditions) of approximately eighty-five cents per head.

Kleanup was less effective on cattle with large, well established faecal dags. However, there was an improvement in overall hide condition through the wash and rinse process. This process would contribute to improved outcomes for Australian cattle being presented for slaughter from feedlots that feed British bred cattle and exposed to wet winter weather conditions.

The Kleanup surfactant contains a bactericidal that may also be beneficial in reducing the bacterial load on cattle immediately prior to slaughter. This claim would need to be tested and substantiated under further research.

This report recommends further investigation in to the effectiveness and potential registration of Kleanup surfactant for use on feedlot slaughter cattle in Australia.

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1 Background

The Australian Feedlot Industry has a one-time capacity to feed 1.25 million head of cattle with a production value of approximately $2.7 billion annually. The feedlot industry is an integral part of the Australian beef industry, producing consistent high quality grain fed beef for both local and overseas markets. Like most industries within the agriculture sector, lot feeding is a margin based value-adding business which requires innovative and emerging science and technologies in order to continually improve and remain profitable.

The presence of mud and dags on hides is a major problem to the cattle feedlot and beef processing sectors due to concerns regarding the welfare and health of animals, worker Occupational, Health & Safety issues associated with current removal approaches, increased costs associated with the cleaning and processing of daggy cattle, and the potential to compromise food safety through carcase contamination.

Dags, a hard dry aggregation of faecal and dirt material, form around and attach to the hair of feedlot cattle during wet winter periods. The adhesion of the faeces to the hair forms a very strong bond, which needs to be broken, in order to remove dags from the hide of the animal.

The removal of dags pre-slaughter is seen by many as the critical control point in reducing or minimising the potential for microbiological contamination of the carcase, thereby increasing the safety of the subsequent meat products.

Many different methods of removal have been identified and trialled. Current solutions fall into two main categories; mechanical removal (includes shearing and hand raking), washing (includes soaking with water, washing with high pressure water and the use of detergents) and various combinations of the two approaches.

However, many of the currently available solutions also have a number of negatives associated with their use, including animal welfare concerns, worker OH&S issues, reduced meat quality, cost and overall effectiveness.

2 Project objectives

The project involved the use of a registered surfactant and washing process (which was installed in an enclosed yard) on a number of animals (three groups of twenty cattle). An assessment of effectiveness of both the washing equipment and the cleaning surfactant was based on the time taken to clean the animals, the change in mud and dag load on the animal (assessed using a previously developed dag scoring system) and treatment cost.

The objective of the project was to install a prototype cattle wash and trial the effectiveness of both the Kleanup washing surfactant and the Stocksprayz cattle wash equipment.

The project will assist in the analysis of a cost-effective solution for the pre-slaughter removal of mud and dags from feedlot cattle that overcomes the animal welfare, OH&S and meat quality issues associated with current solutions used in Australia.

The project also undertook the research activities required to demonstrate the efficiency and efficacy of the solution under field conditions.

The project was conducted at a commercial feedlot site in the South Island of New Zealand situated on the eastern edge of the Canterbury Plain. The trial work was unable to be conducted on livestock deemed for slaughter in Australia as the Kleanup surfactant is currently not registered for use on food producing animals in Australia.

If the trial is assessed as successful, further work will be undertaken to get the process to a standard where it becomes a commercial solution that can be implemented in industry in Australia. The extent of this work is not possible to quantify at this stage.

3 Method

The method developed to conduct the project was partitioned in to various stages:

Stage 1. **Initial site inspection and evaluation process**

Representatives from Meat & Livestock Australia (MLA) and the Australian Lot Feeders Association (ALFA) visited the co-operator beef cattle feedlot in the South Island of New Zealand during September 2013 to gain an overview of the facility and operation, as well as assess the mud and dag load on cattle within the feedlot. Consideration was given to the existing feedlot layout and the potential for positioning a temporary cattle wash facility within the existing infrastructure. Discussions were held with both feedlot management and operational personnel to gain acceptance of the concept, and also to address both party's expectations, the critical success factors and any potential obstacles that could be identified prior to both parties committing and then undertaking the research project.

Stage 2. **Present draft proposal for trial**

A proposal was developed for the recommended positioning of the cattle wash applicator to suit current stock flow, access to an adequate water supply, electricity and a source of pressurised air. For each segment of the project, the involved parties were able to address critical success factors and potential solutions to any identified issues. A risk assessment was conducted for people participating in the trial - handling cattle, operating cattle wash and assessing the cattle prior to and post washing.

Due to the impending change in seasonal conditions from winter to spring at the trial feedlot in the September-October period, the project proposal included practical trial procedures, a limited time frame and recommendations for the product owners, co-operator feedlot and MLA.

Stage 3. **Set up for trial**

The washing equipment was shipped from Australia to New Zealand and installed by a local engineering company on the co-operator feedlot site. The surfactant was shipped to the co-operator feedlot site from the North Island.

Assembly of the equipment was undertaken by the onsite engineer and the Stocksprayz team and involved the positioning, fitting, plumbing and electrical wiring of components on the site. The system layout was provided by Stocksprayz Limited.

Stage 4. **Conduct trial**

Stocksprayz Limited ensured the equipment was installed and set up correctly. During the trial, Stocksprayz personnel also ensured the surfactant mixing rate was correct at all times. The project co-ordinator supervised the trial, and the treatment of an agreed number of cattle - three groups of twenty cattle.

On day one, cattle were selected, assessed and photographed. The following day, cattle were washed, rinsed, assessed and photographed.

A sample of ten cattle were selected at random from each of the three groups, paint branded, weighed after washing, and then weighed again after rinsing.

The assessment was based on visual assessment of cleanliness score using a previously developed dag scoring system (Table 1).

The data collected included visual assessments and photographs recorded both prior to washing and post rinsing, individual cattle tag details and cattle live weights. Cattle were assessed in pairs in a holding pen adjacent to the temporary cattle wash.

Effluent samples were taken during the washing and rinsing process - pre-wash, post wash and post rinse. The samples were then analysed under laboratory conditions to ascertain the level of dilution in the water run-off during the various phases of cleaning.

Stage 5. **Report on trial**

At the conclusion of the trial, a comprehensive report outlining trial process, results and ongoing recommendations will be presented to Meat & Livestock Australia.

An overview of the methodology

Cattle for the project were selected from three groups of cattle on feed at Wakanui Feedlot.

The groups consisted of:

- Group 1: 20 British bred steers - 85 DOF
- Group 2: 20 mixed breed heifers - 30 DOF
- Group 3: 20 British bred steers - 92 DOF

The trial cattle were drafted on horseback from the home feeding pens on the morning of Tuesday 24th September, assessed according to the Australian Muddy Cattle Assessment Key (see Appendix A), photographed, individual tags recorded and the cattle were then held overnight in separate groups in concrete stabilised, clean pens. Misty rain was recorded throughout the day.

On the morning of Wednesday 25th September, cattle from each of the three groups were washed with Kleanup solution for thirty (30) seconds in lots of four cattle at a time. The cattle were then allowed to stand for a minimum of ten (10) minutes prior to a rinse wash of three (3) to four (4) minutes. The time cattle spent in the rinse wash depended on the mud and dag load - rinsing continued until a reasonably clear solution was emanating from the wash bay (see Appendix B).

Cattle were then re-assessed using the Australian Muddy Cattle Assessment Key, photographed and individual tags recorded. Light to heavy rain fell throughout the day with associated wind gusts and squalls.

A sample of ten (10) cattle from each group were randomly selected and weighed individually. These cattle were paint branded and weighed a second time after washing with surfactant and rinsing with clean water. Individual tag numbers and liveweights were recorded on both occasions.

The assessment system reflects the level of risk associated with degrees of muddiness and the ease in which the soiling can be removed. The criteria for assessment are reflective of the conditions experienced in the Australian feedlot environment.

Scores are assigned to each animal according to three body regions:

1. Front - head, neck forelegs and chuck region;
2. Body - midsection of the animal from the back of the scapula to the front of the Sirloin cutting region; and
3. Rear - sirloin, rump, hind legs and tail.

The assessment system is based around a six point cleanliness score from zero (0) to five (5), and includes a three point dag texture score from A to C.

Table 1: The criteria used to assess the cattle prior to washing and post rinsing.

	Texture	**A**	**B**	**C**
Cleanliness Score	**Description**	Loose material only	Fixed dags only	Fixed dags and loose material
0	A body region free of any visible contaminants. The animal will be completely dry			
1	A body region with a very light level of soiling (less than 5% of the body region being appraised). No balling or dagging of adherent material. The animal may be dry to damp			
2	A body region with a light level of soiling (less than 20% of the body region). No balling or dagging of adherent material. The animal may be dry to damp			
3	A body region with a moderate level of soiling (20-50% of body region). Slight balling or dagging of the adherent			

	material may be present. The animal may be dry to damp			
4	A body region with heavy soiling (50-80% of body region). The animal may show a significant level of balling or dagging of adherent material. An animal in this category may be damp or wet but not dripping			
5	A body region with extensive soiling (>80% of body region). The animal will show extensive balling, dagging or clodding of adherent material. An animal in this state may be damp or excessively wet to the point of dripping			

Six liquid samples were taken from the cattle wash during the trial:

- Diluted surfactant prior to application - two samples
- Solution during initial application to the cattle during rinse process - after thirty seconds - one sample
- Solution near conclusion of application to the cattle during rinse process - after one hundred and eighty seconds or three minutes - one sample
- Solution near conclusion of application to the cattle during rinse process - after two hundred and forty seconds or four minutes - one sample

The six samples were analysed for chemical composition by DeLaval Manufacturing, Frankton, Hamilton in New Zealand.

The method used to assess the concentration of surfactant remaining in the effluent water during various stages of the rinse-off phase was foam activity. The foam activity of the used Kleanup solution (1 part concentrate: 40 parts water) and of the water wash runoff collected at selected times during the rinsing process were measured and recorded.

The foam level was measured by transferring 250ml of each sample into a 1,000ml stoppered measuring cylinder and shaking the solution up and down for 30 shakes. The cylinder was placed on the bench and the volume of foam measured using the graduation marks on the cylinder. This analysis demonstrated the rate of surfactant dilution during the rinsing phase.

An analysis of the cost per head to wash and rinse cattle including handling, surfactant, water and electricity was also undertaken.

4 Results

The results of the washing trial on the three groups of lot fed cattle were assessed by comparing the objective Muddy Cattle Assessment Scores for each animal. The first score was established by assessment

of the cattle on removal from the home feeding pen on day one. The second assessment was conducted after washing and rinsing on day two.

Objective conclusions can also be made from the photographs of individual cattle taken prior to the trial commencing, compared with images captured after the washing and rinsing procedure.

The cattle in group one were predominantly Angus, Hereford and Hereford x Angus steers that had been on feed for 85 days. The winter coats were evident with long hair, with some cattle beginning to shed hair along the midrift. Most cattle displayed extensive dags adhered to their hides, with varying degrees of muddiness associated with the presence of dags. This group was chosen as a typical group of cattle that would be presented for slaughter from central and southern regions of eastern Australia during the winter months. The only qualifications would be the hair length and the extensive dags (from prolonged exposure to wet winter weather) present on the trial cattle.

Group two contained Angus, Hereford, Hereford x Angus, Murray Grey, Hereford x Murray Grey and Hereford x Murray Grey x Charolais cross heifers that had been on feed for 30 days. The extensive winter coats were again evident with longish hair. A limited numbers of heifers were starting to shed their winter coats (hair). Many cattle displayed extensive dags adhered to their hides, with varying degrees of muddiness associated with the presence of dags. This group was chosen as a typical group of yearling trade cattle that would be presented for slaughter from central and southern regions of eastern Australia during the winter months. The only qualifications would be the hair length and the extensive dags (from prolonged exposure to wet pens since feedlot entry) present on the trial cattle.

The cattle in group three were all Angus and Hereford x Angus steers that had been on feed for 92 days. Their winter coats were also evident with long hair, and a proportion of cattle beginning to shed, particularly along the lower rib line and underbelly. Most cattle displayed extensive dags adhered to their hides, with varying degrees of muddiness associated with the presence of dags. This group was also chosen as a typical group of mid fed to long fed cattle that would be presented for slaughter from central and southern regions of eastern Australia during the winter months. The only qualifications would be the hair length and the extensive dags (from prolonged exposure to wet winter weather) present on the trial cattle.

Table 2 summarises the assessment scores for each of the three trial groups:

Table 2: Summary of the improvement in Assessment Scores for each trial group and the average change in liveweight from post wash to post rinsing.

	Improvement in Assessment Score			Liveweight Change		
Group	Cleanliness	Loose Material	Dags	Post Wash	Post Rinse	Ave change in LW
1	0.65	0.90	0.00	663.0	656.6	-6.4
2	0.79	0.95	0.00	555.4	546.8	-8.6
3	1.68	1.00	0.00	672.6	663.8	-8.8

The two comparative assessments reveal an improvement in overall cleanliness, albeit in varying degrees, for all three trial groups. The removal of loose material or mud during the washing and rinsing phases is very evident not only in the visual assessment data, but also captured in the photograph comparisons of each animal. This improvement also included the removal of more recently adhered dags, smaller in composition and softer in texture than the longer term larger, more robust dags.

The removal of the larger, coarsely textured and well adhered dags across all three trial groups was almost entirely deficient. However, there was evidence of good cleaning of the hide in between these dags, which improved the overall presentation of the hide, particularly along the brisket, underbelly, cod (or udder), inside flank and twist regions of the cattle washed in the trial.

An interesting point to note is the dirtier cattle (group three) displayed the greatest improvement following washing and rinsing - an increase in overall cleanliness by more than one and half scores.

The liveweight comparisons pre-rinse and post-rinse for each sample group indicate an average loss in weight of approximately eight (8) kilograms. As the cattle were assessed on day one following removal from the home pens, held overnight in three separate concrete stabilised clean pens of similar size, with access to the regular diets and drinking water, then washed, weighed, rinsed and re-weighed on day two as each group participated in the trial, the weight loss may be attributed to the minor stresses that the cattle were exposed to through the process.

However, there may also be a relationship between the average liveweight loss of each sample group and the amount of soluble material removed from the cattle during the washing and rinsing process. From this exercise, it is not possible to determine how much, if any, surfactant remained on the cattle post rinsing.

From the photographs taken prior to the trial being conducted and the photographs taken following the wash and rinse process, it can be determined that most cattle displayed an improvement in overall cleanliness. The visual photographs tend to support the subjective assessment criteria using the Muddy Assessment Key, even though the photographs were captured independently of the assessment by the same person (see Appendix C).

Table 3 displays the results from the laboratory analysis of the samples taken during the washing and rinsing process of a single group of cattle. It can be noted that the rinse process reduced the presence of the higher concentration of diluted surfactant that was initially present when the Kleanup was applied to the cattle. After three to four minutes rinsing time, the concentration of cleaning product had reduced to significantly lower levels. See appendix E.

Table 3: Summary of the analysis of both the diluted surfactant mixture applied directly to the cattle during the washing phase, and the effluent run-off mixture during the rinsing phase with clean water over intervals of 30 seconds, 3 minutes and 4 minutes.

Sample	Rinse Time (secs)	Foam Height (ml)
1	0	400
2	0	350
3	30	110
4	180	70
5	240	40
6	240	30

Table 4 provides the cost per animal to wash and rinse thoroughly. The surfactant is diluted in water before applying to the animal for thirty seconds. The cattle are allowed to stand for ten minutes, and then rinsed with clean water for approximately three minutes.

Table 4: Summary of the cost of Kleanup surfactant and water associated with washing and rinsing cattle.

Cycle	Kleanup (c/hd)	Water (c/hd)	Cost/cycle (c/hd)
Wash	0.83	0.002	0.832
Rinse	0	0.012	0.012
		Total Cost per animal:	**0.84 c/head**

5 Discussion

Cattle were selected randomly from three feeding groups for the trial. Many of the cattle were carrying significant dags on their winter coats, with some cattle displaying signs of shedding their winter coats. Most cattle also carried varying degrees of mud and loose material on their coats, particularly in the brisket and underbelly region. Although the cattle were on average rated highly for dag and mud during the initial assessment scoring, and the cattle were not typical of all cattle raised in Australian wet winter conditions, the trial cattle selected were similar to cattle exiting feedlots in southern Queensland, NSW or Victoria after significant rainfall events during the winter months from July to September.

Whether the chemical make-up of the dags on the cattle used in the trial is similar to those that develop on the coats of Australian cattle is yet to be determined. The length of hair on the cattle assessed during the trial was also deemed to be longer than most feedlot cattle from British breed extraction in Australia.

The washing and rinsing of cattle on day two of the trial was conducted in a small temporary holding pen within the existing yard handling complex. The cattle were quietly handled and washed in lots of four head at a time. After washing, each lot was then stood over until the twenty head in the group had been washed, following which all cattle in the group were then rinsed in lots of four head. Some cattle were less than enthusiastic to re-enter the wash bay a second time, resulting in some cattle not being re-assessed and therefore excluded from the trial.

The wash bay was potentially under-utilised during the cleaning process. It was possible to only load four cattle at a time in to the wash bay due to safety concerns for both livestock and people assisting in the penning up. An ideal number for the wash bay would have been five head to increase livestock density and therefore facilitate even coverage of the cattle, particularly during washing, and also during the rinsing phase. The cattle had to be encouraged manually from outside the wash bay to stand over the rotating jets in order to promote good coverage, sometimes with only moderate success. See appendix B.

The rocking arms on the washing equipment were also set in parallel with the sides of the wash bay. A more effective layout may have been if the arms were at right angles or perpendicular to the sides of the wash bay in order to facilitate improved coverage of the cattle. This was not possible due to the limitations of the existing yard structure for appropriate installation of the equipment, particularly given the washing equipments predetermined design for the original project in Australia. See appendix B.

The weather on the second day was inclement, with intermittent wind gusts and showers, resulting in poorer quality photographic images of individual cattle for comparison with those taken the previous day prior to washing. However, the images obtained support a valid comparison of cattle prior to being treated with Kleanup and post washing.

The cattle were slightly more agitated on the second day following washing, rinsing and a second session of being penned in pairs for assessment and photographing. Combined with the weather elements, this led to the assessment being undertaken in a slightly different format to the previous day, and may have influenced the final results (although not markedly).

The Kleanup solution appears to be readily washed from the cattle during the rinsing phase. The dilution of the surfactant in the effluent rinse-off water supports the premise that only minimal amounts of surfactant remain on cattle after washing and rinsing with clean water (see appendix E).

6 Conclusion

The trial conducted on three groups of twenty cattle from different feeding regimes, where cattle were assessed on day one for dag and mud load on their coats, washed, rinsed and re-assessed on day two, showed that the Kleanup surfactant and Stocksprayz washing system was effective in reducing visible mud, loose material and minor dags.

The reduction in faecal loads on the trial cattle was supported by subjective assessment using the Australian Muddy Cattle Assessment Key, photographic evidence of individual cattle and the overall reduction in liveweight during the cleaning process. The extent that the Kleanup and wash was effective was very much dependent on the degree of dirtiness of each animal prior to the cleaning process.

The reduction in loose material was obvious and consistent across all cattle participating in the trial. As can be noted in several of the photographs in appendix D, and supported by the visual assessment information

in the tables of appendix C, most cattle were significantly improved in the brisket, underbelly, cod/udder and inside flank areas. For example, the cattle in photographs 2, 7 and 11 display an improvement in hide cleanliness in specific areas after washing. The photographs 8, 10 and 13 provide good evidence of hard, well established faecal load being in partial stages of dissolvement during the cleaning process. Further time rinsing may have improved the effectiveness of the overall wash process.

The ability to remove or dissolve significant faecal dags during the Kleanup and Stocksprayz cleaning process was less convincing. However, the hide area between dags was significantly improved, leading to the conclusion that an improvement in the cutting line area at slaughter could be improved with the cleaning process. This area will need to be analysed further, as the dag load, chemical composition of the faecal dags, length of coat hair and timing of washing prior to slaughter will influence the final outcome.

The trial on sixty head of cattle under New Zealand conditions displayed enough evidence for the Australian Lot Feeding industry to justify further investigation of the Kleanup cattle wash surfactant under Australian conditions. The Stocksprayz cattle washing equipment is also worthy of further trials, as the unique washing/rinsing action using only moderate amounts of water has significant benefits for the Australian industry. Due to the low pressure washing action, there appears to be minimal hair removed from the animals coat during either washing or rinsing.

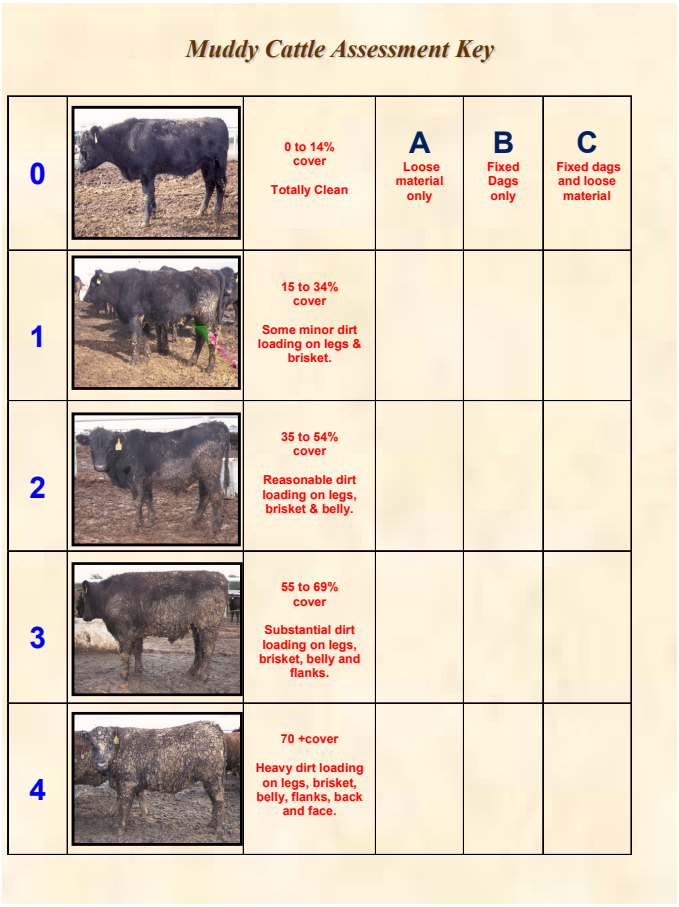
The calculated cost of washing was approximately eighty-five cents per head. Given the low stress environment that washing can be undertaken, the short time frame that cattle are penned during the process, limited hair removal and the moderate amount of water used for washing and rinsing, this process provides a cost effective solution to preparing feedlot cattle for slaughter.

The Kleanup surfactant also contains a bactericidal that may be beneficial in reducing the pathogen or bacterial load on cattle immediately prior to slaughter. This aspect is worthy of further investigation as there are obvious benefits at pre-slaughter washing of feedlot cattle that not only reduces the prevalence of mud and loose material from the hides of cattle, but may also minimise or reduce the potential for pathogenic or bacterial contamination of carcasses through the slaughter area and therefore provide additional food safety benefits.

Based on the information collated and the observations in this trial, there is strong justification for industry to investigate further the potential of Kleanup solution and the Stocksprayz cattle washing equipment in preparing feedlot cattle for processing under Australian conditions.

7 Appendix A

The Australian Muddy Cattle Assessment Key can be used to score cattle for the degree of muddiness, and also in relation to the amount of loose (mud or faeces) or fixed (dag) material adhering to the hide of individual cattle.



Scores are assigned to each animal according to three body regions:

1. Front - head, neck forelegs and chuck region;
2. Body - midsection of the animal from the back of the scapula to the front of the Sirloin cutting region; and
3. Rear - sirloin, rump, hind legs and tail.

Cleanliness scores are as follows:

0: A body region free of any visible contaminants. The animal will be completely dry

1: A body region with a very light level of soiling (less than 5% of the body region being appraised). No balling or dagging of adherent material. The animal may be dry to damp.

2: A body region with a light level of soiling (less than 20% of the body region). No balling or dagging of adherent material. The animal may be dry to damp.

3: A body region with a moderate level of soiling (20-50% of body region). Slight balling or dagging of the adherent material may be present. The animal may be dry to damp.

4: A body region with heavy soiling (50-80% of body region). The animal may show a significant level of balling or dagging of adherent material. An animal in this category may be damp or wet but not dripping.

5: A body region with extensive soiling (>80% of body region). The animal will show extensive balling, dagging or clodding of adherent material. An animal in this state may be damp or excessively wet to the point of dripping.

8 Appendix B

The photographs below display the method used to wash cattle at Wakanui Feedlot. The holding pen was a temporary construction that consisted of enclosed steel panels, a concrete base and a single enclosed gate access point.

The Stocksprayz equipment was fitted to the enclosure. The surfactant was mixed with water in a mixing tank prior to being sprayed on the cattle. Clean water was used from the same source during the rinsing procedure.

9 Appendix C

The following three tables contain the individual animal identification tag correlated with the assessment scores both pre-wash and post wash/rinse. The tables also indicate the photograph numbers for reference and the sample ten head from each group that was individually weighed.

The tables contain a crude score for improvement in cleanliness, a reduction in loose material and a reduction in dags adhered to the hide after washing and rinsing

Group 1

		24/09/2013				25/09/2013					
ID Tag	Breed	Photo	Score	No	Weight	Photo	Score	Weight	Cleanliness	Loose Material	Dags
3826	A	3826a	2C	2	646	3826b	2B	642	0	1	0
3827	HA	3827a	4C	10	674	3827b	3B	660	1	1	0
3879	H	3879a	3C	4	620	3879b	2B	614	1	1	0
3880	H	3880a	3C			3880b	2B		1	1	0
3882	H	3882a	1C			3882b	0B		1	1	0
3890	A	3890a	1C	1	662	3890b	0B	658	1	1	0
3895	A	3895a	3C	8	696	3895b	2B	690	1	1	0
3947	HA	3947a	1C			3947b	0B		1	1	0
3959	HA	3959a	3C			3959b	2B		1	1	0

3964	A	3964a	4C	9	686	3964b	3B	680	1	1	0
4000	HA	4000a	2C			4000b	1B		1	1	0
4010	HA	4010a	3C	3	666	4010b	3B	658	0	1	0
4016	HA	4016a	3B			4016b	3B		0	0	0
4017	HA	4017a	3C	6	686	4017b	2B	678	1	1	0
4020	HA	4020a	3C	5	624	4020b	3B	620	0	1	0
4034	HA	4034a	3B			4034b	3B		0	0	0
4042	H	4042a	2C			4042b	1B		1	1	0
4046	H	4046a	2C	7	670	4046b	2B	666	0	1	0
4047	H	4047a	3C			4047b	2B		1	1	0
4048	A	4048a	3C			4048b	3B		0	1	0
				Ave.	**663.0**		**Ave.**	**656.6**	**0.65**	**0.90**	**0.00**

Group 2

ID Tag	Breed	24/09/2013 Photo	Score	No	Weight	25/09/2013 Photo	Score	Weight	Cleanliness	Loose Material	Dags
7901	H	7901a	2C	4	636	7901b	2B	630	0	1	0
7903	H	7903a	2C			7903b	2B		0	1	0
7905	HA	7905a	2C	7	640	7905b	2B	632	0	1	0
7906	H	7906a	2C			7906b	1B		1	1	0
7910	A	7910a	4C	8	536	7910b	3B	528	1	1	0
7914	H	7914a	2C	2	498	7914b	2B	478	0	1	0
7918	H	7918a	1C			7918b	1B		0	1	0
7919	MG	7919a	2C			7919b	1B		1	1	0
7921	H	7921a	3C	3	526	7921b	2B	520	1	1	0
7923	CHMGX	7923a	3C	9	570	7923b	2B	568	1	1	0
7924	A	7924a	3C			7924b	2B		1	1	0
7949	MG	7949a	3C	10	520	7949b	1B	512	2	1	0
7956	HA	7956a	3C			7956b	1B		2	1	0

7963	H	7963a	3C			7963b	2B		1	1	0
7974	H	7974a	2C	1	530	7974b	2B	518	0	1	0
7978	A	7978a	3C			7978b	could not get steer in to cattle wash				
7980	H	7980a	3B	6	556	7980b	2B	548	1	0	0
7981	HMGX	7981a	3C			7981b	1B		2	1	0
7983	MG	7983a	2C	5	542	7983b	1B	534	1	1	0
7989	A	7989a	2C			7989b	2B		0	1	0
NT	A	Nta	4C			NTb	4B				
				Ave.	**555.4**		**Ave.**	**546.8**	**0.79**	**0.95**	**0.00**

Group 3

ID Tag	Breed	24/09/2013 Photo	Score	No.	Weight	25/09/2013 Photo	Score	Weight	Cleanliness	Loose Material	Dags
3155	HA	3155a	3C	1	666	3155b	3B	660	0	1	0
3160	HA	3160a	3C			3160b	2B		1	1	0
3164	HA	3164a	3C	7	724	3164b	1B	714	2	1	0
3168	HA	3168a	3C	8	658	3168b	1B	650	2	1	0
3172	HA	3172a	2C	4	688	3172b	0B	680	2	1	0
3180	A	3180a	3C			3180b	2B		1	1	0
3195	A	3195a	3C			3195b	1B		2	1	0
3198	A	3198a	3C			3198b	2B		1	1	0
3199	HA	3199a	3C			3199b	0B		3	1	0
3210	A	3210a	3C			3210b	2B		1	1	0
3236	A	3236a	3C			3236b	1B		2	1	0
3253	A	3253a	2C	5	682	3253b	0B	672	2	1	0
3266	A	3266a	3C	10	670	3266b	0B	646	3	1	0

3286	A	3286a	3C			3286b	2B		1	1	0
3297	A	3297a	3C	6	640	3297b	1B	636	2	1	0
3325	A	3325a	3C	3	652	3325b	3B	648	0	1	0
3340	A	3340a	4C			3340b	3B		1	1	0
3344	A	3344a	3C	2	672	3344b	0B	664	3	1	0
3368	A	3368a	3C	9	674	3368b	0B	668	3	1	0
				Ave.	**672.6**		**Ave.**	**663.8**	**1.68**	**1.00**	**0.00**

10 Appendix D

DeLaval

LABORATORY REPORT

Date: 8th October 2013

Test Required: To assess the effectiveness of water washing cattle following application of Kleanup Cattle as a washing process.

Sample Source: Samples received from Richard Kettle of AHD Limited on 1st October 2013 and held in the refrigerator until testing was arranged.

Test Process; The foam activity of the used solution (1 part concentrate : 40 parts water) and of the water wash runoff collected at selected times during the rinsing process were measured and recorded. The foam level was measured by transferring 250mL of each sample into a 1000L stoppered measuring cylinder and shaking the solution up and down for 30 shakes. The cylinder was placed on the bench and the volume of foam measured using the graduation marks on the cylinder.

Results:

Sample	Rinse Time	Foam Height
1	0	400mL
2	0	350mL
3	30 sec	110mL
4	3 minutes	70mL
5	4 minutes	40mL
6	4 minutes	30mL

Conclusion: The rinse process rapidly reduced the presence of the higher level of surfactant that was initially present when the Kleanup Cattle was applied to the coat surface. It indicates that a rinse time of about 3 to 4 minutes is appropriate for the removal of the cleaning product from the cattle to very low levels.

11 October 2013.

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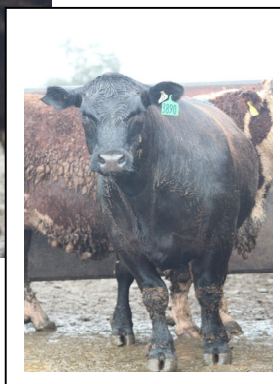
11 Appendix E

The following photographs provide examples of the improvement in hide condition post washing (30 seconds) and rinsing (3-4 minutes):

Photographs 1a & 1b: Group 1, steer, ID 3827

Photographs 2a, 2b & 2c: Group 1, steer, ID 3882



Photographs 3a, 3b & 3c: Group 1, steer, ID 3890

Photographs 4a & 4b: Group 1, steer, ID 4034

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3. Warren Jones, Napier, New Zealand