Australian Government
Cotton Research and Development Corporation

FINAL REPORT 2017

For Public Release

Part 1 - Summary Details

Please use your TAB key to complete Parts 1 & 2.

CRDC Project Number: **1514**

Project Title: Development of Revolutionary Float Actuated, Fully Automatic, Flow regulating Valves.

Project Commencement Date: 1 / 9 / 2014 **Project Completion Date:** 1 / 6 / 2017

CRDC Research Program: 1 Farmers

Part 2 – Contact Details

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Date Submitted: 25/6/2017

Part 3 – Final Report

(The points below are to be used as a guideline when completing your final report.)

Background

The Cocky Flow™ was originally designed for farmers receiving water from the channel irrigation network in Hanwood near Griffith. Many of these open concrete channels were being changed over to pipe through a number of schemes many funded by the federal government. This was causing significant problems, as the water now being provided to the farmer was under pressure (some times as high as 8 – 12 psi or an equivalent head pressure of 5 – 8 meters).

Murrumbidgee Irrigation together with a local contractor brought this matter to our attention in May of 2013. I subsequently developed Cocky Flow™ to address this problem. The Cocky Flow™ regulator valve automatically regulates the flow back to the 1 : 1 flow rate for which the farmer's distribution systems are designed. As the water level rises in the receiving pit the floats cause a sleeve within the valve body to rotate and adjust the flow. This sleeve has a specifically designed aperture that can vary the flow rate from full flow, down to lower flow rates as required simply and automatically. These head pressures and flow rates can vary significantly over a day as irrigators come on and off the system. The Cocky Valve™ simply adjusts itself to suit the particular pressure and subsequent flow rates required at that time.

A further requirement was to supply a valve to combine a full shut off mechanism. I subsequently designed and built the first Cocky Flow N Stop™. This valve went through a development process over many months and won National Farm invention of the Year at the 2013 Orange Field days. I am confident Cocky Flow™ and the Cocky Flow N Stop™ regulating valves address all the main issues raised by MI and the customers receiving the piped water. Both the Cocky Valve™ and the Cocky Flow N Stop™ prototypes were then tested with the results presented to MI.

Rather than be the end of the development process this was really only the very beginning. The initial valves while appropriate for a receiving pit did not necessarily suit all installations in particular large open channels. I then went about developing a valve that had all of the attributes of the initial smaller valves but in a form that would be scalable and appropriate for large channel networks. This design is now completed and has been tested in a 600NB size with designs now available from 200NB up to 1800NB and even larger if required.

The process has led to the development of other valves such as a revolutionary Non-Return Valve, a new design for inlet valves as well as a new design for a high flow pipe outlet valve used in surface irrigation.

Objectives

1. **List the project objectives and the extent to which these have been achieved, with reference to the Milestones and Performance indicators.**

The objectives of this project were initially to finalise the design for the flow regulating valves associated with the change over from open channel supply to pipe supply. However, it quickly became apparent that there was an opportunity to offer valves into a variety of other configurations. We have therefore developed a new non-return valve that is unlike anything else in the market. This will have significant impact on any installation where large pumps are required as these valves ensure that the pump remains fully primed therefore increasing the ability to manage these processes remotely. We have now fabricated these valves in a variety of sizes and conducted some limited field trails. These trails have provided invaluable feedback which has allowed us to further refine our designs that are now low cost, effective and most importantly should prove extremely reliable and robust in the field.

Methods

2. Detail the methodology and justify the methodology used. Include any discoveries in methods that may benefit other related research.

The methodology adopted was basically in three steps. Design, Materials, Manufacture.

- Firstly, we needed to complete our designs. Much of this initial work was done more in a 2D drawing environment. We then moved into a 3D design model using AutoCAD software but still it was somewhat lacking. Finally, we redeveloped all of our design model in a 3D design software using a package called Solidworks. This package allows the design to be interrogated intensely to the point where we can view the actual projected flow vortex that the valve develops.
- Then we had to decide on the type of materials to be used. We decided early on that we should use SS316 material wherever possible. It seemed clear to us that this material was stable, relatively easy to use and was able to withstand the rigors of the environment. We could have used Galvanised steel or even Aluminium but SS316 was simply the best material for our valve designs. The bearings and bushes have gone through a number of trails both in design and material type. We have now settled back predominately using a Vesconite material which again is just so easy to us, and incredibly hard wearing and stable in virtually any environment where our valves will be exposed. This decision was based largely on our internal review process together with direct feedback from field trials.
- Once we had our materials decided we need to finalise our manufacturing. This took a lot of time and effort before reached a final decision. When you first start it is easy to think you can do everything yourself. We went through the process of costing various machines, looking for facilities, costing labour etc and it was just becoming a huge and expensive exercise. We then tried doing some of the assembly and minor fabrication ourselves and subletting out all of the major components. This simply proved too long and too expensive to adopt long term We therefore began working with the Victorian Government in order to identify a likely manufacturer that could do the lot. We were lucky enough to be introduced to Hilton Manufacturing in Dandenong. A family business of many years who have the capacity and more importantly the vision to help us solve all of our manufacturing problems. They have a state of the art facility with all of the modern machinery and most importantly the no how to take our designs and rejig them to allow cost effective manufacturing.

Results

3. Detail and discuss the results for each objective including the statistical analysis of results.

By breaking the process down into three distinct objectives allowed us to move through the process methodically. I spent a great deal of time designing the various valves without spending a great deal of time thinking about the material. Once the designs were well established we then incorporated the material type and adjusted our designs to suit material sizes available and also looked at the strength of the material so we could reduce material thickness due to the strength of the SS316 we were using. The same method was then adopted for the bearings and bushes. Finally, with the design and material established we needed to decide on the manufacturing process. This ultimately resulted in us deciding to outsource the entire manufacturer to a recognised leader in their industry.

The results we have achieved through this process has been excellent.

Outcomes

4. **Describe how the project's outputs will contribute to the planned outcomes identified in the project application. Describe the planned outcomes achieved to date.**

   The overall plan for these valves, was to develop flow regulating valves that would deliver ***economic, environmental and social benefits to the industry and to the people of Australia.***

   I believe the various valve designs we have been able to develop, model and trial will achieve this plan. We have been able to secure feedback from various farmers as to the value our valves can deliver. The enthusiasm for our valves is fantastic with a variety of large scale farmers wanting to trial them. We have further trials planned for Jerilderie, Kununurra, Goondiwindi and Coleambally. Now that we have our designs finalised and manufacturing sorted we can immediately move into marketing and distribution.

5. **Please describe any:-**
   a) **technical advances achieved (eg commercially significant developments, patents applied for or granted licenses, etc.);**
   We have been able to secure a Worldwide patent for our Flow Regulating Valves covering ALL countries where significant irrigation is used. We have also applied for and remain confident we will secure, another worldwide patent covering our Non-Return Valves and various adaptations thereof. To secure a patent for a regulating valve associated with large scale irrigation is a significant achievement let alone securing two worldwide patents. Without the support provided by this development grant we may never have been able to achieve these results.
   b) **other information developed from research (eg discoveries in methodology, equipment design, etc.); and** We have had to develop purpose built machines to enable cost effective manufacturing. This is especially the case in regards to the Non-return valves which utilise a half sphere as a major structural component. These shapes and manufacturing techniques have NEVER been adopted or utilised anywhere within the Irrigation sector. It is exciting to be bringing state of the art design and manufacturing to the broadacre irrigation sector.
   c) **required changes to the Intellectual Property register.** All intellectual Property remains under our control and ownership. We intend these designs to remain Australian Owned and manufactured.

Conclusion

6. **Provide an assessment of the likely impact of the results and conclusions of the research project for the cotton industry. What are the take home messages?**

   The main benefits to the cotton industry are three-fold. Our valves provide an economic and reliable solution to the adoption of automation across a large irrigation system. Currently, there remains the need for significant manual adjustment and monitoring of the system. Our valves therefore allow farms to automate their systems without the need for any power supply, require little if any manual monitoring and provide security over their infrastructure.

   - Our valves are able to be pre-set to allow a channel to fill to a specific height. This is achieved by a system of floatation and counterweights which do not require any power to operate. They can be operated remotely by mounting a solar driven drive mechanism but this only to open or close the valves and would only be required on specific systems.
   - Once the level is set..... that's it. There is NO NEED TO MONITOR. The valve adjusts the flow automatically. So the need to have employees monitoring channel height is no longer required.

- The valves secure the channel infrastructure. As I have been told on numerous occasions it ***"is not necessarily the cost of the water, it is the cost in yield if you can't water when required"***. Our valves provide security over the delivery infrastructure and therefore the ability to water when required.

Extension Opportunities

7. **Detail a plan for the activities or other steps that may be taken:**

(a) to further develop or to exploit the project technology.

We are now developing a wider range of valves covering virtually all installations. We will shortly have designs for Inlet valves, Outlet valves, Non return Valves and Flow Regulating Valves in sizes from 200NB up to 1800NB. The work completed to date provides a platform for taking our valves into the market nationally and then in time internationally.

(b) for the future presentation and dissemination of the project outcomes.

We intend to use the outcomes from this development program in much of our marketing strategies moving forward. We intend to disseminate details of our valve designs to a wide range of irrigation sectors. We will initially focus on the large scale cotton growers and then look at rice, vegetable and other crops that may benefit from our valves.

(c) for future research.

Our valves have been described by two professors in applied fluid dynamics as a "*breakthrough in design*". We would welcome the opportunity to work with other designers in taking the design concept into other areas of fluid management. This may include wetlands rejuvenation, the mining industry, flood mitigation etc. The options are wide and we would welcome the opportunity to work with other designers.

9. **A. List the publications arising from the research project and/or a publication plan. (NB: Where possible, please provide a copy of any publication/s)**

Apart from our Patent Applications there are no publications.

B. Have you developed any online resources and what is the website address?

We have registered a new company and company structure and intend to market under Cocky Irrigation. We have registered the domain but have not yet created the actual site. This should be live from October 1st this year.

When I received a call at 8.30pm one evening I had no idea where this "Cold Call" would lead. It was from a drainage contractor working in Hanwood near Griffith. They were changing over many of the open concrete channels to pipe systems and therefore were encountering head pressures that they had never experienced previously. This was causing significant problems, as the water now being provided to the farmer was under pressure (some times as high as 8 – 12 psi or an equivalent head pressure of 5 – 8 meters). This increase in pressure results in an increased water flow of 4 – 8 times what the irrigators were previously receiving. In many instances, the farms were simply not set up for this level of water flow and the receiving systems would quickly break down with significant water loss and cost the result.

The Cocky Flow™ regulator valve using a buoyancy float and counterweights automatically regulates the flow back to the 1 : 1 flow rate for which the farmer's distribution systems are designed. As the water level rises in the receiving pit the floats cause a sleeve within the valve body to rotate and adjust the flow. This sleeve has a specifically designed aperture that can vary the flow rate from full flow, down to lower flow rates as required simply and automatically. These head pressures and flow rates can vary significantly over a day as irrigators come on and off the system. The Cocky Valve™ simply adjusts itself to suit the particular pressure and subsequent flow rates required at that time.

A further requirement was to supply a valve to combine a full shut off mechanism. I have now designed and built the Cocky Flow N Stop™ flow regulating valve now available in three different configurations and sizes from 200NB up to 1800NB. This valve went through a detailed development process before winning the 2013 National Farm Invention of the year at Orange Field days.

Cocky Flow™ regulating valves are Full Flow at low pressure providing the customer with the same flow as they have always received. Their existing systems will continue to operate exactly as they have always done regardless of the delivering pressure and flow rates. Our aim is to provide valves that can deliver ***economic, environmental and social benefits to the industry and to the people of Australia.***

Our valves carry worldwide patents and we now have designs for Inlet Valves, Outlet valves, Non-Return Valves and Flow Regulating Valves in sizes from 200NB up to 1800NB.

Our aim was to bring world class current technology into the process, but to simplify and not complicate the outcome. We see the way that some technologies are being applied to the irrigation sector as being totally against this philosophy. Complicating the final product without simplifying and improving reliability we feel is a backward step. We feel many of the "AUTOMATED" processes being applied as unnecessary and self-serving.

By contrast, Cocky Valves are simple to operate, reliable and enable the grower to maximise his yield, while reducing water use and enabling better outcomes from his labour base. They secure the growers infrastructure and provide a cost-effective and reliable solution to automated irrigation in broad acre farming.

Provide a one page Summary of your research that is not commercial in confidence, and that can be published on the World Wide Web. Explain the main outcomes of the research and provide contact details for more information. It is important that the Executive Summary highlights concisely the key outputs from the project and, when they are adopted, what this will mean to the cotton industry.