Effluent Treatment Plant – White Elephant or Water Resource?

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A GLOBAL WATER CRISIS

There is, without doubt, consensus that we are facing a world-wide water crisis. Rapid urbanisation, industrial development and ever increasing demands being forced on our available resources are placing unrealistic pressures on the globes finite supply of water. Global distribution of water is geographically established and in the modern populated world its location has little correlation to human activity. With some of the world's poorest and least developed communities found in some of the driest or most erratic rainfall regions of the world, demand for water will continue to be overriding. Global annual water consumption has risen six-fold in the last century, double the rate of population growth, compounding the United Nations forecast that suggests two thirds of the world's population, or an estimated five and a half billion people, will by 2025, be living in water stressed areas. While human battles will continue to be stoked by demand for resources, our unprecedented need for water has now become the primary catalyst for world conflict.

The divergent demands, benefits and consequences of industrial, mining and agricultural water use, with those of the basic survival needs of individuals and communities will continue to damn the search for an elusive balance. The interdependence of both, in an ever more complex and integrated world, will and is, placing increasing demands on both governments and modern corporations to balance the interests of all parties. Given Africa's rapidly emerging status as a resource rich

investment destination with a burgeoning middle class brandishing increasing levels of disposable income, global corporations burdened by first world financial woes, are arriving in droves. Major players in the beverage industry now well established in Africa, have projected a particularly positive outlook for their involvement on the continent. As a major consumer of water this industry will need to ensure it positions itself at the forefront of not only water conservation but total resource and catchment management.

AFRICA – AN OPPORTUNITY

The results, reported in 2009 by SABMiller, of an extensive Water Footprinting exercise undertaken in South Africa, under the guidance of the World Wildlife Fund found then, that it took an average of 155 litres of water to produce 1 litre of beer. Noticeably 95% of the water used was during the agricultural phase. (SAB Miller plc Sustainable Development Report 2009). Taken across all producers, the world-wide in-brewery average production ratio is currently in the order of 5.5 hl water/hl beer produced. With African Breweries in most cases lagging behind, it is suggested that the Sub-Saharan in-brewery average production ratios can be found somewhere in the 7 to 8 hl water/hl beer range! In many instances brewery infrastructure is old and has been poorly maintained. The winds of change sweeping the continent have seen a massive reinvestment in plant, people development and resource optimisation. New breweries are being developed and old ones reinvented. With initially production being the driving motivation, this is rapidly being replaced by a realisation that sustainability will only be achieved by supplanting the realities of potential resource limitations with the opportunities presented by Africa's rapidly expanding consumer markets. With many African countries already water stressed, compounded by rampant urbanisation and failing infrastructure, the conflicting needs of a high water use industry is mirrored against the poverty of un-serviced informal settlements, clinging to the fringes of fraying cities. Against this reality a brewery producing one million hl of beer per year will use, in a single day, the equivalent water that would supply a family in such a settlement for some 15 years!

Many African cities, laid out in the last century, exist with infrastructure crumbling under the strain of years of neglect and burdened by an influx of modern day fortune seekers. Poor planning has resulted in them being ill equipped to cope with the needs of modern day commercial enterprise. Water supply, electricity, sanitation and waste disposal limitations along with congested transport networks add to the challenge of doing business in these burgeoning economies. For years this environment tolerated discharge mismanagement and the lack of capacity prevented effective monitoring or measurement of waste. This is changing – improving community resources and increasing social awareness, driven by a youthful population well aware of their changing economic and social status are demanding more responsible citizenship. Perceived as cash flush such enterprise is likewise seen as a ready contributor to institutional taxation, be it by levy, tariff or fine.

BREWING IN AFRICA

It is against this backdrop that modern day brewery operators will need to redefine their position. Many breweries old or new have associated effluent management infrastructure, few breweries derive any real benefit from this investment. Fewer still acknowledge the importance of this component within the beer production cycle. Focused on producing beer, challenged by environmental constraints, limited resources and unproductive support, management restricts itself to the end product. Incapacitated effluent plant is justified by dereliction, left to the garden service to operate and cannibalised as a source of much needed and urgent spares, its presence at the bottom of the compound is solely attributed to a planner's prerogative. In commercial terms without a quantitative bottom line contribution there remains little reason for its existence.

In the quest for increasing efficiencies driven by the need to attract transferable capital, corporate decision makers are increasingly demanding the sweating of all assets. Assumed last in the progression of improved performance across the brewery site, the effluent treatment plant offers potentially significant measurable returns to the producer. With some 50 odd breweries located across Sub-Saharan Africa, an effluent treatment plant at today's value of approximately USD

3,000,000 suggests a combined commitment of some USD 150,000,000 of largely unutilised investment. Realising a return on this perceived non-core asset on any brewing site requires a fundamental realignment of expectations.

Local management will need to reposition the effluent plant within the brewery context, accepting the unique requirements associated with its efficient operation and resourcing such accordingly. Of critical importance is the need to associate its operation within defined and determinable parameters and manage it as a contributing component of the greater objective. Environmental compliance is today a given and discharge must be compliant. The market that buys the end product is demanding this, as is the planet itself. Add to this the potential to recover water and harness the energy produced, requires that the technology employed is not only appropriate but functional and that management is committed to ensuring the end point is achieved.

THE EFFLUENT TREATMENT PLANT

Throughout the brewery, gains in performance deliverables will begin with equipment enhancement and modernisation, improved process coordination and sequences and the training and development of both management and supervisory capacity and operational personnel. The same process is required if benefits are to be derived from the effluent stream. Without a systematic approach endorsed and supported by senior management, functional improvements and appropriate resourcing, effluent treatment assets will remain yesterday's structures. Infrastructure which is in a failed or neglected state will require a planned and managed approach, to where necessary, rehabilitate such and thereafter achieve optimal performance. Integration of the effluent treatment process to within the entire beer production life cycle is fundamental, as is management commitment to ensure and enforce compliance.

A brewery effluent treatment plant is designed primarily to ensure that effluent emanating from the beer production process is returned to either the environment or local sewerage reticulation system

in a state that will not harm this receiving environment. Multiple factors will affect the operation and performance of an effluent plant. Condition and age of the production site, incoming water supply processing, product, product components and production methods, training and motivation of operators as well as additives and cleaning agents will all impact on the final effluent. Configuration and location of the effluent plant and associated infrastructure needs to be considered as does its maintenance state and operator competence.

Waste streams sent to the effluent treatment plant will vary by way of source, within the production cycle, influenced by temperature, pH (figure 1.), hazardous substances, cleaning agents and solids ranging from fine silica particles to bottle tops and glass shards. Within the brewery the principal focus of the effluent treatment plant remains the removal of organic substances measured by chemical oxygen demand (COD)(figure 2.) and nutrients. For this reason effluent should initially be subjected to operationally integrated separation. Kieselguhr, yeast and brewers grain being identified as separable within the production facility. Primary treatment of effluent would then entail screening to remove any obstructing particles such as labels, bottle tops, cullet and crate or bottle shards. This would be followed by effluent storing to achieve equalization prior to the secondary step involving biological treatment. Depending on the age of the existing infrastructure, available space and production capacity of the primary facility, treatment may be either aerobic or anaerobic. In modern applications anaerobic followed by aerobic presents as the most efficient treatment. Tertiary treatment involves polishing the final effluent prior to discharge or reuse. Polishing may involve settling by way of a clarifier or more modern technologies incorporating membrane biological reactors (MBR) or membrane filtration ranging through nano to reverse osmosis (RO). Without labouring the chemical and physical processes associated with the defined technology, performance of the entire treatment train remains reliant on not only the state of the equipment but the ability to provide and support qualified and dedicated operators.

Figure 1. positioned here

Figure 1. pH relationship by brewery production cycle (after Devolli, A., et al (2010))

Figure 2 positioned here

Figure 2. COD relationship by brewery production cycle (after Devolli, A., et al (2010))

Herein lies a significant change of heart for brewery managers. Until status is given to the role of the effluent plant and its contribution acknowledged within the greater whole, even the best equipment and most modern infrastructure will fail to deliver on the most basic of expectations. Repairing, replacing and modernising the associated infrastructure is the first step, however the critical step is the implementation of a clearly defined process management system. Given the rapidly varying composition and quantity of effluent and the biological nature of the process, competent operators need to be equipped to not only handle a living process but respond to its fluctuating demands. On-going planned maintenance is a further requirement essential in placing the effluent treatment plant on a sound footing, able to contribute rather than just comply. Planned maintenance, as with any other asset, is a non-negotiable.

The acceptance of brewers to increasingly reduce, re-use and recycle inputs throughout their production facilities has resulted in numerous step changes which in turn present further implications for effective effluent management. Reduction in water usage results in less wastewater, which ultimately further concentrates effluent components. Production integrated waste management should focus on the separation, removal and where possible re-use of waste within the production facility itself. This further highlights the importance of a comprehensive detailed and integrated plan emanating from the senior echelons of the brewery hierarchy.

RESOURCE RECOVERY

In achieving performance, compliance becomes attainable. The benefits of performance are ultimately captured and valued in the sustainable harvesting of identified renewable resources presented by the compliant plant.. Water recovery and biogas harvesting for energy production are

immediate benefits, determined by effluent characteristics and consequent to further investment. Biogas infrastructure, with a payback of less than 3 years, against the average brewery is generally harvested for use in a brewery boiler. Water recovery may vary from straight forward polishing for use on gardens to potable grade water for use within current general standard provided there is zero contact or inclusion with or within product. Available recovery technology, competently managed, may achieve water recovery standards of between 60 and 70% of compliant brewery effluent. Compliant, specifies effluent free of foreign objects, excessive solids determined by settleable volume (SV) or extreme pH values. The evident benefit, particularly in the case of water recovery is the measurable contribution to overall facility water consumption reduction. Payback calculations will vary based on the cost of water, determined largely by its source of supply. Notwithstanding such, the benefit of the overall reduction of site consumption will enhance the long term sustainability of the operation within its greater environmental, commercial and importantly social catchment.

CONCLUSION

Africa's rapid transformation to an economic destination of significance requires that cognisance of its social, environmental and commercial impacts are considered. Stakeholders will need to share the responsibility of ensuring equal access to the continent's most valuable resource; water. Environmental abuse will need to be curtailed if the continent is to sustain its population. Water use minimisation and optimal recovery should be considered not only as an economic prerogative, but an environmental obligation. By ensuring the judicious use and reuse of available resources, brewers will not only enhance sustainability, but ensure that they protect the market they supply. With this same emergent consumer market buoyant on the pickings of a latent resource boom, corporations and individuals will need to be mindful of an increasingly discerning end user.

REFERENCES

Davies, P.S., (2005). The Biological Basis of Wastewater Treatment. Strathkelvin Instruments Ltd.

Devolli, A., Shabani, A.L., Mali, A.S., Hila, N., (2010). Brewery Wastewater Management. Balwois, Ohrid, Republic of Macedonia.

Freeman, B., Peck, S., Sherwood, B., (undated). Optimization of an Industrial Wastewater Treatment Plant through implementation of a Membrane Bioreactor and Reverse Osmosis system for reuse. Hydranautics, Oceanside, CA 92058.

Rosenwinke,l K-H., Austermann-haun, U., and Meyer, H., (undated). Industrial Wastewater Sources and Treatment Strategies.

SAB Miller plc Sustainable Development Report 2009

Wiesmann, U., Choi, I.S., Dombrowski, E-M., (2007). Fundamentals of Biological Wastewater Treatment. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim.