

The Waste Tyre Problem in South Africa: An Analysis of the REDISA Plan

Nhlanhla Nkosi, Edison Muzenda, John Zvimba and Jeffrey Pilusa

Abstract—This paper reviews the proposed REDISA Plan which is meant to address the waste tyre problem. The study objectives were achieved through reviewing the REDISA gazetted Plan and interviewing REDISA personnel. The Plan does not address waste tyre problem only but has the potential to contribute to job creation, capacity building, establishment of small businesses as well as research and development of new and innovative waste tyre utilization techniques. The Plan is seen as the only viable approach to remedy the waste tyre problem through the introduction of a proposed levy fee of R2.30, and all tyre producers and dealers are expected to subscribe to the plan. Despite it being gazetted, the plan is still awaiting implementation.

Keywords—Recycling, REDISA Plan, tyre hierarchy, waste tyres

I. INTRODUCTION

WASTE tyres present a challenging disposal problem. The same properties that make tyres desirable such as durability, in turn make their disposal and reprocessing a challenge. Tyres are immune to biological degradation due to their complex nature. Land filling has been the only feasible waste tyre management strategy so far. However tyres take up plenty of land space and they pose fire, environmental and health risks [1], their disposal at landfill sites has been banned. The South African government is looking for alternative and ecologically friendly waste tyre disposal options. The Recycling and Economic Development Initiative of South Africa (REDISA plan) has been accepted in accordance with the National Environmental Management Waste Act, 2008 (Act No. 59 of 2008) as stated in the Government Gazette, 17 April 2012, No.35147.

REDISA, registered as REDISA NPC (2010/022733/08) is a non-profit making organization representing various people

Nhlanhla Nkosi is with the Department of Chemical Engineering, Faculty of Engineering and the Built Environment, University of Johannesburg, Doornfontein, Johannesburg 2028, (email: nkosinhlahlal@gmail.com)

Edison Muzenda is with the Department of Chemical Engineering, Faculty of Engineering and the Built Environment, University of Johannesburg, Doornfontein, Johannesburg 2028, tel: +27115596817, fax: +27115596430, (email: emuzenda@uj.ac.za)

John Zvimba is with the Department of Natural Resource and Environment, Pollution and Waste Research Group, Council of Scientific and Industrial Research, Brummeria, Pretoria 0001 (email: JZvimba@csir.co.za)

Jeffrey Pilusa is with the Department of Mechanical Engineering Science at the University of Johannesburg, Auckland Park, South Africa (e-mail: pilusat@webmail.co.za)

and organizations in the tyre and waste tyre industry. “The REDISA plan is industry independent and meets all Government requirements for handling the waste tyre problem in a sustainable manner. Furthermore and importantly, the REDISA plan fosters and generates new business and employment opportunities in line with Government imperatives. This plan includes the informal sector, for example, those people who burn tyres to access scrap metal for a living” [2].

The Department of Environmental affairs is tasked with protecting the environment and public health. The Waste Management Act declares its objectives as being to protect human health and well-being as well as the environment. This Act, in Section 28(1), addresses waste management options for waste that occurs in more than one province. The Act anticipate the need to address national issues with a holistic national plan, hence the REDISA plan was drafted taking cognisance of this. The REDISA Waste Tyre Management Plan is consistent such objectives. The REDISA plan as proposed is the most viable approach to waste tyre management

II. WASTE TYRE HIERARCHY

All tyre assortments that are imported or manufactured, including locally retreaded tyres, will reach the end of their useful life and become waste tyres need to be managed. According to REDISA, the annual projection of the quantities and types of tyres that are manufactured or imported will be managed through the Integrated Industry Waste Management Plan. For the ease of waste tyre management, tyres will be divided into nine categories as listed in Table I.

TABLE I
TYRE CATEGORIES

Category	Type of tyre
1	Passenger tyres
2	Light commercial tyres
3	Heavy commercial tyres
4	Agricultural tyres
5	Motorcycle tyres
6	Industrial tyres
7	Aircraft tyres
8	Earth moving tyres
9	Any other pneumatic tyres

Similar to the general waste hierarchy [3], waste reduction and avoidance form the foundation of the waste tyre hierarchy.

This is succeeded by recycling, re-use and recovery as the last option is considered, Fig. 1.



Fig. 1 Waste tyre hierarchy

A. Waste Tyre Avoidance and Reduction

At present, consumers generally drive their tyres to destruction. Priority will be given to preventing and reducing waste tyre generation through the launching of awareness campaigns regarding the maintenance guidelines and procedures recommended by tyre producers. The aim of which is to promote, among tyre consumers, the importance of keeping their tyres in good condition and thus extending the lifespan of the tyres. Secondly, the REDISA plan will encourage investment in the retreading industry and actively promote the use of retreaded tyres. Used tyres classified as retreadable by tyre dealers as required in terms of regulation 7 (1) of the Waste Tyre Regulations of 2009 to be directed to retreading plants.

Passenger tyres can be retreaded once whilst heavy commercial tyres can be retreaded three or more times depending on the condition of the casing. Other categories of tyres such as industrial and agricultural can be retreaded up to ten times. The National Regulator for Compulsory Specifications (NRCS) will be encouraged to make the present voluntary retreading standards for passenger tyres, South African National Standards SANS 0108, and commercial tyres, SANS 20109, compulsory in order to raise the tyre consumer's present low opinion of retreaded tyres [4].

B. Re-use

The re-use of a product is defined in the Waste Act, 2008 as "utilising articles from the waste stream again for a similar or different purpose without changing the form or properties of the articles". The re-use of waste tyres is defined as "the utilisation of waste tyres, in whole or in parts, without changing the composition of the tyre". Casing can be used for retreading; every retreaded tyre provides second life to the tyre. Retreading of high performance tyres is a common practice in Europe [4], but rarely done in South Africa, due to the lack of funding associated with the establishment of suitable plants and also because of consumer and dealer preconceptions. The REDISA plan will promote and support the establishment of recycling facilities nationwide. These facilities create employment opportunities for the informal sector and previously disadvantaged individuals in both urban and rural communities. The collection of waste tyres to the

depots and /or tyre processors will be the main source of job creation and the establishment of small businesses [4]. Table II shows the various re-use applications of waste tyres, used as whole, cut or shredded.

C. Recycling

Many recycling processes require significant capital investment, which in turn necessitates assured long-term supply of the raw material to enable them to recoup the investment. As a result, one of the most vital roles of the REDISA Plan is to manage the flow and supply of tyres to recycling operations to ensure sustainability of those facilities. Over time, the range of products recovered through the recycling process will be expanded to other products such as oil [4]. An infant recycling industry exists in South Africa at present with crumbing plants in operation. A number of companies involved in the cutting and punching products from tyres are also in operation.

TABLE II
VARIOUS APPLICATIONS FOR WHOLE, CUT OR SHREDDED TYRES

Application	Material				Source	Technology
	W	C	S	C		
	hole tyre	cut tyre	shred	chips		
Embankments	x		x	x	PW, TW, MW	M, A
Erosion control	x	x	x	x	PW, TW	M, A
Landfill engineering	x		x	x	PW, TW	M, A
Slope stabilization	x		x	x	PW, TW	M, A
Temporary roads	x		x	x	PW, TW	M, A
Thermal insulation	x		x	x	PW, TW, MW	M, A
Collision barriers	x	x	x	x	All	M, A
Light weight fill	x		x	x	PW, TW, MW	A
Noise barriers	x	x	x	x	PW, TW, MW	M, A
Train and tram train beds				x	PW, TW	M, A, C

Key for TABLE II

Sources		Technology (size reduction)	
P	Whole		Mechanical (cut, compress)
W	passenger tyres	M	
T	Whole		Cryogenic
W	truck tyres	C	reduction
	Mixed		
M	whole		Ambient
W	car/truck tyres	A	reduction
A			
LL	All		

South African (SA) Tyre Recyclers was formed in late 2005 in order to establish the country's most modern tyre recycling facility. This facility is situated in Atlantis, Cape Town, and operates with a recycling capacity of about 10,000 tonnes per annum. SA Tyre Recyclers work closely with local authorities and government bodies on recycling issues and environmental matters regarding post-consumer tyres [4]. Some of the products are (i) tyre shreds are used in matting, sport surfaces,

turf and playgrounds, (ii) granules and chips are used in athletic tracks, playgrounds, horse arenas and asphalt (iii) crumbs and powders are used in new tyres, brake pads, road sealing, adhesives and paints (iv) large shred tyre chips are used in civil engineering and fuel derivatives. The facility is fully operational and addressing the growing waste tyre problem. Table III shows various applications for waste tyre rubber in South Africa.

TABLE III
VARIOUS APPLICATIONS OF WASTE TYRE RUBBER

Application	Material
Concrete additives	construction
Asphalt additives	
Asphalt rubber	
road furniture	

Material	Sources	Technology (size reduction)
Granulate	P Whole passenger tyres	Cryogenic size reduction
Powder	T Whole truck tyres	Ambient size reduction
Buffings	M Mixed whole car/truck tyres	Devulcanization
Reclaim	A All	Reclaim
Devulcanizates	LL	Pyrolysis
Pyrolytic products		
Upgrade material		

Applications to produce industrial and consumer products include sport surfaces, indoor safety flooring, playground surfaces, shipping container liners, conveyor belts, automobile mats, footwear, carpet underlay, roof tiles, flooring and activated carbon [6].

D.Recovery

Virtually no energy recovery from waste tyres is taking place in South Africa currently but alternatively their use in industrial processes, such as cement, lime or steel production and power stations world-wide is well documented and accepted. The authorization of the use of waste tyres as a substitute for fossil fuel is done on a plant by plant basis according to the existing provisions of the Waste Act, 2008 and the Department of Environmental Affairs (DEA) National Policy on thermal treatment of general and hazardous Waste.

III. WASTE GENERATION

South Africa is considered as one of the fastest growing economies and the growth is realised through the bulk industrial production of goods to meet the socio-economic needs of the growing population. Approximately 10 million tyres per year are currently sold in South Africa. All these

tyres, (except tyres exported) will become waste tyres. Fig. 2 shows the projected waste figures for an annual increase of 1 million new tyres over a period of five years [7].

A consistently increasing trend was experienced and projected for the period of 2010 to 2014 with exception of 2011. This could be attributed to the fall in new tyre sales by 1.5 million units in South Africa in 2011 [8]. This might have been a consequence of recession in the previous year which weakened production in the manufacturing sector. Most of the tyres for 2011 were imports.

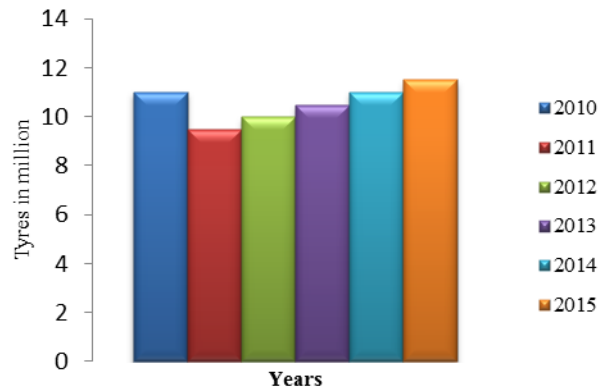


Fig. 2 waste tyre projection figures [6]

IV. THE REDISA PLAN

Fig. 3 shows the REDISA Plan waste tyre hierarchy. The particular recycling process shown is illustrative and will evolve as the project develops.

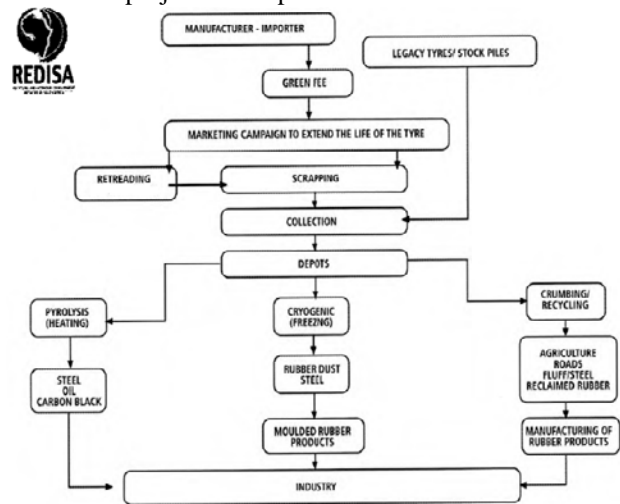


Fig. 3 The REDISA waste tyre hierarchy

The basis of the REDISA Plan centres on the following fundamental aspects:

Job creation: Attaching a value per kilogram to waste tyres provides small entrepreneurs and the previously disadvantaged with opportunities to earn income by delivering tyres to 150 depots throughout South Africa. REDISA aims to specifically identify micro operators, provide the relevant training and

create business opportunities by awarding specific collection points, thereby ensuring sustainability. The regulation of the transporters will enable them to have a stable base income.

Additional income opportunities will be created through the transportation of recycler's output products (which will be paid for by the recyclers or their customers), and the opportunities that the transporters will have of using their return trips profitably instead of travelling empty. The training and education programme is essential to assist the transporters in exploiting these additional opportunities. Training for transporters is a compulsory component of the REDISA plan.

- *Small Medium-Micro Enterprises (SMMEs) and Broad-Based Black Economic Empowerment (BBBEE):* One of the biggest hurdles faced by SMMEs is access to capital. Establishment of depots requires funding that the SMMEs do not generally have access to. Under the REDISA plan which addresses the entire industry, depots will initially be funded by REDISA and leased to BBBEE entrepreneurs. This has the secondary advantage that should a depot fail through mismanagement as it is invertible that out of 150 depots some will, it becomes easier to re-start operation with new management. Managers of these depots can over time, as they themselves become fully self-sustaining, take over full ownership of their depots.
- *Need for informal participation:* Tyre manufacturers and importers must shoulder the primary responsibility for waste management. In practise it must be recognised that once the tyres leave manufactures or importers they have no further contact with them. It is the tyre dealers who handle them through their life cycle, and the management approach must fit in with the practicalities of the retail industry. The informal sector deals with a large proportion of the waste tyre, estimated to be at least 75% [4]. Thus, without informal sector participation no plan will succeed, hence the plan must be inclusive of this sector.
- *Fairness:* Any implementation of new regulations and taxes or levies will inevitably attract criticism and opposition, no matter how praiseworthy or fruitful the aims may be. The strongest argument against such opposition is fairness. Multiple plans, unless essentially the same plan replicated in different pretexts, will always be seen to be unfair to one or more parties. A single plan approach, with a simple and equitable system for apportioning the waste tyre management fee will simplify administration and auditing. As a result, the plan will be far less open to suspicions of behind the scenes manipulation by the influential participants.
- *Finance and audit control:* The management of waste

tyres on a national scale is a massive task involving very large sums of money. Proper financial management is essential, not only to avoid losses due to errors and omissions, but also to combat the unavoidable attempts for misuse that will arise. Any plan needs to have strict controls, but the more complex the system becomes, the harder it is to close the ambiguities that dishonest individuals will seek.

There will be multiple plans implemented for the project in order to prevent the deliberate misallocation of stock or the movement of tyres between the plans to gain advantage. Multiple plans mean that every participant in the tyre industry would have to comply with multiple set of rules and be subjected to multiple audits. There are approximately 2300 tyre dealerships nationally [4], and hence the scale of potential problems is huge, as would be the remedial cost.

- *Training and communication:* The REDISA Plan will provide various training programmes in order to equip all stakeholders with the relevant skills and competencies. Similarly, there will be a need to market the concept of waste tyre recycling and encouraging participation. A single plan with consolidated funding is not only more effective, but the message is simpler and can easily be communicated.
- *Resilience and longevity:* The REDISA plan is a viable venture with guaranteed viability and ready translation to related fields. There are many other sources of environmental waste which can and should be alleviated similarly such as electric goods, small appliance batteries, compact fluorescent lights and many other forms of waste. This can contribute towards a fund to cater for the eventual safe recycling and disposal of these goods [4]. It is a fundamental concept with a relatively simple underlying structure, which avoids affiliations with particular industry players and is structured to carry out government mandate.
- *Subscribers to the plan:* Any tyre producer, waste tyre processor or stockpile owner having received a registration number from the Department of Environmental Affairs, in terms of part 3 of the Waste Tyre Regulation must become a subscriber to the plan for as long as the REDISA Plan is the only Integrated Industry Waste Tyre Management Plan (IIWTM) approved by the minister. For the proper implementation of the Plan, all subscribers are expected to sign a deed of adherence acknowledging the existence to the IIWTM and the requirements of the Waste Tyre Regulations. In addition, subscribers are required to provide a monthly declaration of their production (including rejections), imports and exports to the external accounting company.

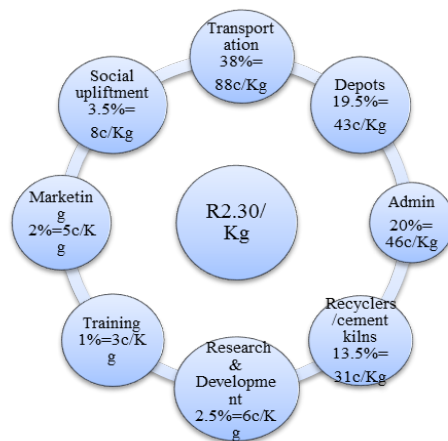


Fig. 4 Initial cost allocations

The waste tyre management fee levied by REDISA on the subscribers will be calculated to recover the cost of the waste tyre management process. The fee will be levied on both produced and imported tyres. The Plan will raise funds from the levied fee of R2.30 per kilogram (kg) and the fee will be reviewed annually to meet demands. The cost is calculated taking into account the initial cost allocations, Fig. 4. From a research point of view, for the early implementation stages of the Plan, the 2.5% allocated should be sufficient. As the plan develops and grows, unconventional primary and secondary products will be discovered through research and development initiatives. Thus, more funds will be required for research and development in the long run.

V. ABATEMENT OF HISTORICAL WASTE TYRE STOCKPILE

Legacy waste tyres denote tyres that are currently usable, generally on vehicles, which will eventually become waste tyres. No waste management fee will be levied for these tyres, but they will need to be addressed at some time in the future. Historical waste tyres are tyres that are already waste but are not part of a registered stockpile. REDISA will primarily concentrate on avoiding the establishment of new waste tyre stockpiles and subsequently deal with legacy waste tyres and historical waste tyres as soon as it starts collecting them. The first two years of the plan will be spent building capacity for waste tyre processes. As soon as sufficient capacity is available, REDISA will allocate a portion of the capacity towards the abatement of historical waste tyre stockpiles. Fig. 5 shows how REDISA envisions purging off the legacy tyres and stockpiles within the plan.

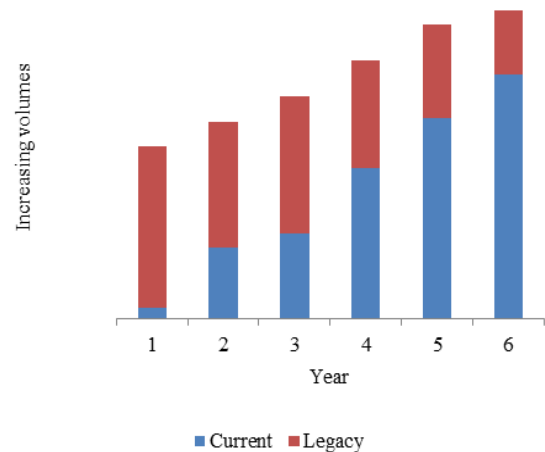


Fig. 5 Abatement of legacy stockpiles [4]

VI. CONCLUSION

The proposed REDISA Plan has come at a time when South Africa needs to reinforce stringent laws on their waste management strategies in particular the waste tyre problem. Before the proposition of the plan no clear approach was used to tackle the accumulation of waste tyres at landfill sites and illegal stockpiles. Beside, addressing the waste tyre problem, the plan also helps with job creation, capacity building, and creation of small businesses and as well as research development of new and innovative techniques on waste tyre utilization. Despite the various challenges and criticism the plan has received from competitors, it has been gazetted and only awaits the implementation stage. The authors support the REDISA plan as a well thought solution to the waste tyre problem.

ACKNOWLEDGMENT

The authors are grateful to National Research Foundation (NRF) of South Africa and the Council for Scientific and Industrial Research (CSIR) for financial and technical support.

REFERENCES

- [1] A. M. Cunliffe and P. T. Williams, "Composition of oils derived from the batch pyrolysis of tyres", *Journal of Analytical and Applied Pyrolysis*. Vol 44, pp 131–152, 1998.
- [2] REDISA Plan Approved, www.crown.co.za/news
- [3] Department of environmental affairs, National waste management strategy. 2010.
- [4] Recycling and Economic Development Initiative of South Africa (REDISA). Government Gazette, 17 April 2012, No.35147
- [5] <http://satyreyclers.co.za>, accessed 06 January 2013.
- [6] K. N. Hylands, V. Shulman, Civil engineering applications of tyres. Independent Transport Research, Consultancy & Testing, 2003.
- [7] Integrated industry waste tyre management plan of the retail motor industry organisation, 13 FEBRUARY2009
- [8] Interview conducted with Mr Pohn, Satrp, REDISA Employee, 15 February 2013