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Reusing tennis balls

Reutilización de pelotas de tenis

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Resumen

Este trabajo tiene como fin atraer la atención a la necesidad de recircular productos de consumo para reducir su impacto en el medio ambiente al ser desechados. Se enfoca particularmente en el redireccionamiento de uso secundario de las bolas de tenis, las cuales tienen una vida útil muy corta y frecuentemente terminan como basura con su subsecuente acumulación. Se presentan tres ideas donde se busca que sean factibles de llevarse a cabo a un nivel individual: un tapete, un asiento en suspensión, y la fabricación de medios escalones. Este última es una idea con un alto potencial de ayudar a la movilidad de las personas envejecientes con un costo bastante modesto.

Palabras clave: Movilidad de adultos envejecientes, Pelotas de tenis, Redireccionamiento de uso.

Abstract

This work is intended to raise awareness on the need to recycle consumer products in order to reduce their impact on the environment when discarded. It focuses particularly on the repurposing secondary use of tennis balls, which have a very short lifespan and often end up in waste stream with their subsequent accumulation. Three ideas are presented looking for feasibility to be carried out by individuals: a mat, a suspended chair, and half steps for stairs. The latter has the potential to aid elder mobility at a low cost.

Keywords: Adult mobility, Reusing, Tennis balls.

1. Introduction

Tennis balls are required to play the sport of tennis. For every tennis match, whether it is a match, a training session, or a casual game, it is common to use a new set of tennis balls, usually purchased in triads in a plastic container. A player who uses a new set of balls every week would end up consuming, in 52 weeks 156 balls per year. As debatable as this profile can be, the fact that the US Physical Activity Council (https://www.physicalactivitycouncil.org/) estimates that 21.64 million people played tennis regularly in the US during 2020, gives an idea of the number of balls consumed just in that year. Tennis balls are frequently lost or misplaced in a tennis match, and after they are deemed unfit for play or training, the large majority of them are simply discarded. Indeed, the whereabouts of used and discarded tennis balls are often unknown in spite of their copious quantity [1] The main material used to manufacture these balls is rubber, and with the final components added to them, estimates of their decomposition time are consistently expressed in the order of hundreds of years [2].

Much can be discussed and elaborated on who has the responsibility is to diminish the impact of accumulation of discarded tennis balls in the environment and the broad and complex systems of incentives, drivers, policies, and coordination necessary to approach this goal. This manuscript avoids these issues and focuses on a simpler idea: at the individual level it is possible to reuse used tennis balls to cover every day needs. In reuse, it is implicit that additional processing is necessary to create a solution to a particular need, as exemplified by the many ideas presented in [3] and [4]. Used tennis balls are known to keep excellent mechanical properties, which explains the efforts in using them in cost-effective construction as shown in [5] for sheds and [6] as seismic isolators. Indeed, sports organizations have also become aware of the need to reduce the impact of equipment waste [7] by setting up recycling and reuse programs [8]. Deepening the search for efforts to recirculate tennis balls, it is possible to find examples where formal engineering systems can assist to this end. Grinding of tennis balls used to create composites for impact dissipation is described in [9]. Seismic design in Civil Engineering has also been a target of tennis balls recirculation, as established in [10]. Moreover, the creation of companies to support a circular economy has also been tested in the world, although not with complete success as described in [2], attesting to the difficulty of the endeavor. Indeed, going from collecting tennis balls to developing an actual product that meets a demand, under an economic incentive, with convenience in the entire supply chain has become an active area of interest in

universities**,** as shown in efforts at the U. of Vermont [11] and at The University of Bath [12].

This manuscript then presents three simple individual and prototypical ideas for the reuse of used tennis balls: (i) the assembly of a mat, (ii) a suspended chair, and (iii) half-steps for stairs. An effort has been made to pair simple domestic needs with convenient solutions based on reuse of tennis balls as reported in [13]. For these ideas to be successful, they would require, however, a third component: an economic benefit [14]. Although the first two projects have savings associated to them, it is the third project that the authors believe could lead to a significant saving for an individual.

2. Materials and equipment

The materials used to conduct these three ideas included used tennis balls, followed by steel wire and cardboard. A standard cutting knife was used where necessary, and a soldering iron helped soften the rubber to facilitate wire insertion.

3. Experimental methods

The three ideas presented in this work followed a similar general procedure of ball preparation and assembly. Four basic operations useful in these projects are illustrated in Figures 1a through 1d: cutting, heating, piercing, and assembly.

(i) The assembly of a mat

The objective of this first project was to exploit the integrity of the shape integrity of the tennis balls, their cushioning properties, and potentially their aesthetics to create a mat. Additional desired properties in this application were for the mat to be flexible and modular. The first one to allow for storage and the second one to allow for covering a larger area by absorbing new subassemblies. The preparation phase includes planning for the desired configuration and the number of balls. In particular, in this instance, a 5 x 7 matrix was sought for a total of thirty-five balls, which would amount to seven cans of tennis balls. The assembly required to soften the rubber of each ball and diametrically pierce it with the steel wire. This was repeated for five units and then these were assembled orthogonally following the same procedure to create the 5 x 7 matrix. The assembly can support a person on top either standing or lying down without losing integrity (Figure 2). Maximal weight tested was 185 pounds (84.82 kilograms). It is difficult to walk on top of the mat, however, it can provide support and cushion for sitting or lying down. With this in mind, a next idea to try is to use the mat as a suspending support for a chair.

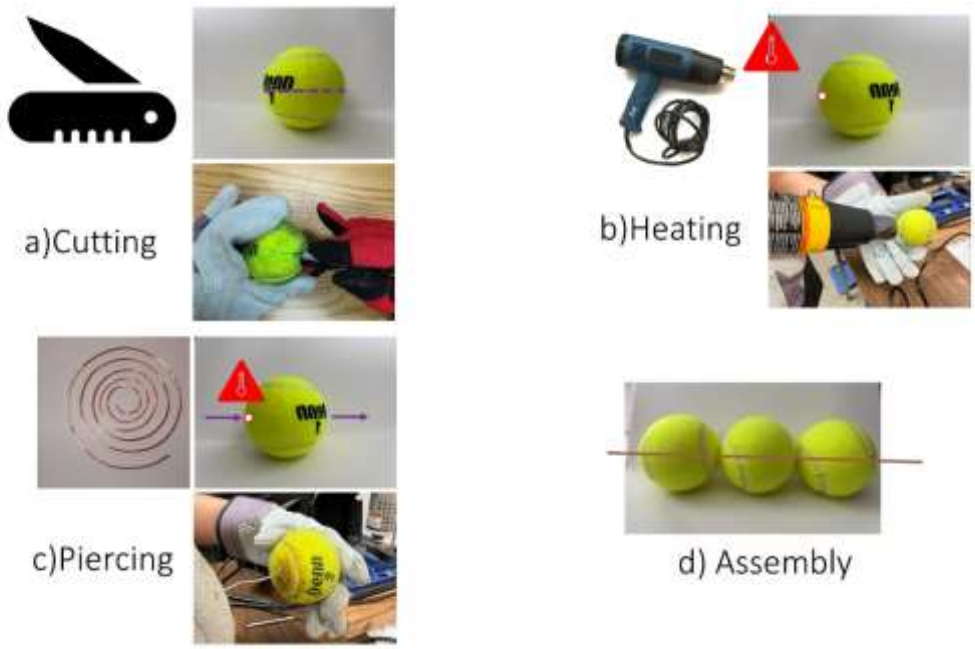


Figure 1. a) Cutting, b) Heating, c) Piercing, d) Assembly.



Figure 2. Tennis Balls Mat Prototype.

(ii) A suspended chair

The mat in the previous section can be used as a sitting cushion by simply lying it on top of a sofa or chair. A different challenge is to use it as a sitting surface without support underneath. To this end, it is required to have a structure to hang the mat. The structures, in this case, was provided by two other garden chairs made out of iron. The wires that shape the tennis ball mat helped to fasten it to the iron chairs. This is, in fact, the single most important part, as these are the knots that are more likely to fail than the mat itself. Once the mat was attached to the other two chairs (Figure 3), a 170 pounds person was able to support himself without complication. The costs associated with the mat and suspended chair provide a modest economic saving. Their main driver is the demand for a product that can be conveniently met with reused used tennis balls. A more significant economic impact can be appreciated in the following project.



Figure 3. Tennis Balls Chair Support.

(iii) Half-steps for stairs

Older adults are known to develop mobility problems. It only takes a sight of our own grandparents trying to walk up a staircase to realize how critical it is to pay attention to this problem. Building a ramp to either replace or coexist with an existing staircase is a solution that not everyone can afford. Costs for building a ramp that is compliant with construction codes can vary between 5 to 15 thousand dollars in the USA and Puerto Rico, in these authors own experience. Of course, more complicated approaches, such as an electric lift or the use of robotic legs could be adopted, but these will not be any cheaper. Considering that tennis balls keep their shape, their mechanical properties, and can be stacked, the idea is to build half steps with them.

Half steps cover half of the height of a step in a staircase, aiming to reduce by half the effort of raising one leg in the climbing process. Once the first leg is supported the other leg can be raised with more confidence.

A prototype of this idea can be appreciated in Figure 4. The prototype is made up of twelve half tennis balls stacked up two at a time to form columns in a 2 x 3 arrangement. Being a prototype, it only has cardboard planes to serve as the half step surface up to this point.

Fastening will be critical to carry this prototype to an actual working condition. It will need to guarantee that the half step remains integral and safe for use. However, even at this initial stage, the idea covers the need for support for older adults to climb stairs (demand), which can be covered by reusing (convenient) used tennis balls, and their use can lead to savings of thousands of dollars in house modifications (economy).



Figure 3. Half-Step Prototype.

4. Discussion of results

The projects described here are geared towards implementation by individuals. In their development, three distinctive characteristics were sought: their ability to solve a problem, their convenience for implementation, and their possibility to have a positive economic impact. It is clear that the simplest ideas also have the most modest economic impacts. The project of manufacture half steps with reused tennis balls is the one that can be developed further to positively impact on the quality of life of elder people without a large investment. It is also the one that can recirculate the largest amount of discarded tennis balls. According to the Center for Disease Control and Prevention [15], there were 34,000 deaths due to falls among adults 65 and older, in 2019. Fall incidents resulted in 3 million visits to emergency rooms by older adults. It is estimated that USD $50 billion in medical costs are spent annually due to adult falls. These numbers demonstrate the pertinence of this project.

5. Conclusions

Human activity generates waste. Sports is no different. This work emphasizes the need to recirculate tennis balls. To this end, three simple reuse ideas are presented as options for individuals to conveniently use discarded tennis balls to meet different domestic needs in a convenient manner. Particular attention is given to the construction of half steps to aid elderly people to climb stairs, where social impact and economic savings have the largest potential. A follow-up survey with potential adopters of these ideas will be undertaken in the future.

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