

**Título** Sustainable construction and demolition waste management in Buenos Aires City, Argentina

---

**Tipo de Producto** Ponencia (texto completo)

---

**Autores** Tufaro, M.; Berdugo, J.; Contrera, S.; y Bielsa, R.

---

Código del Proyecto y Título del Proyecto

---

C16T01 - Gestión sustentable en residuos de la construcción y demolición

---

Responsable del Proyecto

---

Bielsa, Raquel

---

Línea

---

Ciencias Agroambientales

---

Área Temática

---

Agroambiental

---

Fecha

---

Septiembre 2016

---

**INTEC**

Instituto de Tecnología

**UADE**



# SUSTAINABLE CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT IN BUENOS AIRES CITY, ARGENTINA

M.F. Tufaro<sup>a</sup>, J.M. Berdugo<sup>a</sup>, S. Contrera<sup>a</sup>, and R.O. Bielsa\*<sup>a</sup>

<sup>a</sup>Facultad de Ingeniería y Ciencias Exactas, Universidad Argentina de la Empresa, Lima 717, Buenos Aires, Argentina, mtufaro@uade.edu.ar, jberdugo@uade.edu.ar, scontrera@uade.edu.ar, rbielsa@uade.edu.ar

\*Corresponding Author: rbielsa@uade.edu.ar

## Abstract

Construction and demolition waste (CDW) generation has been identified as one of the mayor issues in the construction industry due to its direct impacts on the environment as well as the efficiency of this industry. The importance of waste management needs to be understood to encourage stakeholders to achieve goals in minimization of waste to final disposal of Zero Waste Law of the City of Buenos Aires, Argentina. CDW accounts 2,400 of 6,000 tons per day of solid waste generated in the city so its proper management is relevant to reach zero waste law goals. In this paper, it is analyzed current CDW management model in Buenos Aires City to identify and assess the industry's strengths and weaknesses. This analysis is relevant given the decisive impact of the management model on technical and viability of using the end product (recycled aggregate) in new application in construction. First, a diagnosis on present management of CDW in the city was performed applying qualitative and quantitative research approaches. Interviews were conducted to stakeholders of CDW management (professionals, contractors, clients, academic sector, and authorities). CDW plant in Buenos Aires was visited and main factors to optimize recovery of materials from CDW were assessed.

The present model was found to be characterized by private collection of mixed CDW in site containers of five cubic meters capacity and collection in the lose form is usual only in small constructions. Thirty six authorized transporters do the pick up and transportation of the collection receptacles. The waste is received by one sorting facility constructed by local government and commissioned to a private company for operation of the plant. This facility is a stationary one using fixed equipment for sorting, crushing and screening of the waste. By means of these mechanical operations, the mixed input stream is separated into different material fractions, such as wood, metals, plastics, and mineral components of various size classes. The commissioned operator of the plant sells stone, soils and concrete right away as secondary material in construction activities, but parts of wood and plastics, which do not match the quality requirements for recycling, are sent to final disposal in sanitary landfills. It is estimated that this non recyclable portion is about 20% of the input CDW.

Legislative framework has been not established yet by national and local governments so their roles in the management model are still limited to environmental inspection of plants.

Finally, it is recommended to establish a new CDW management legal framework to promote CDW recycling, incentive used of recycled aggregated and participation of private initiatives to reduce its environmental impacts and increase efficiency in construction industry.

*Keywords: construction and demolition waste management, City of Buenos Aires, Argentina.*

## INTRODUCTION

Construction and demolition waste (CDW) generation has been identified as one of the mayor issues in the construction industry due to its direct impacts on the environment as well as the efficiency of this industry (Elias Castells, 2009). CDW is among the primary source of solid waste generated in the City of Buenos Aires, Argentina. The economic crisis has shown a strong impact on the construction industry and therefore also in the volumes of CDW generated ([www.indec.gob.ar](http://www.indec.gob.ar), 2016) in recent years. Although this crisis, it is estimated that in the city Buenos Aires about 2,000 tons per day of CDW are generated, which represent between 25 and 30% of all solid waste generated ([www.ceamse.gob.ar](http://www.ceamse.gob.ar), 2016).

In Argentina, there is no national legislation governing CDW management. Therefore, each municipality manages CDW in its scheme of MSW. The main method of solid waste management in Argentina is still landfilling and disposal in dump sites according 2010 reports (PAHO, AIDIS and IDB, 2011). However, increasing environmental concerns, legislative and public pressures have led to consider other treatment technologies for municipal solid wastes mainly in big cities where land is scarce and landfills face strong public opposition. The main urban area in Argentina is Buenos Aires Metropolitan Area (Area Metropolitana de Buenos Aires, AMBA) with 12.8 millions of inhabitants, representing 32% of Argentina total population according last national census in 2010 (INDEC, 2016).

City of Buenos Aires is the center of AMBA, formed by the City of Buenos Aires and twenty four municipalities of Buenos Aires Province. Each municipality is responsible for the collection, transport and final disposal of municipal solid wastes (MSW). There is no disposal facility in the city of Buenos Aires; all of them are located in suburban municipalities located in the Province of Buenos Aires (Figure 1).

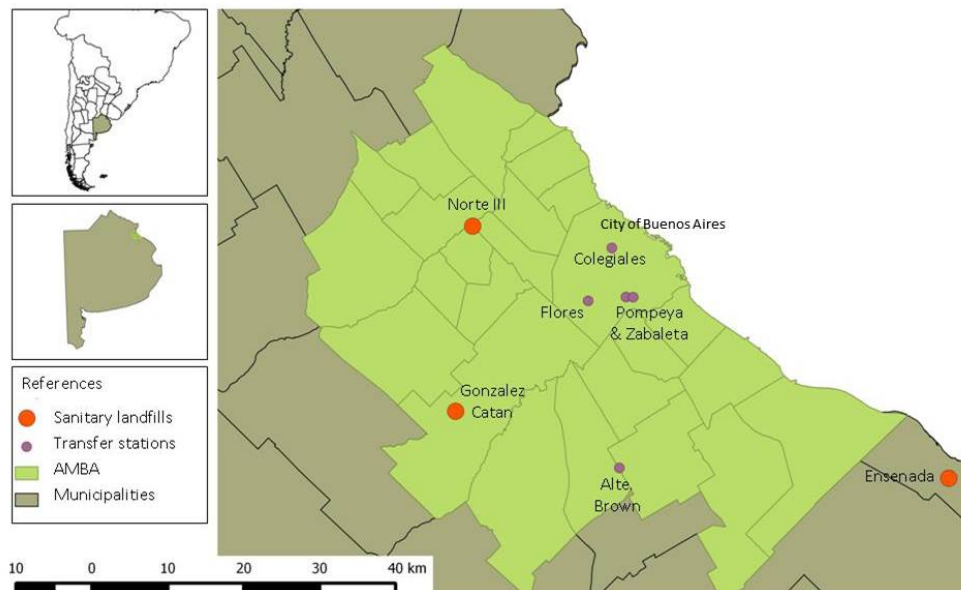


Figure 1: The study area: Buenos Aires City. Location of transfer stations and landfills.

Until 1978, the MSW generated by AMBA was disposed of in uncontrolled “open dumps” and/or incinerated in facilities that polluted the air with their emissions. In 1977, the *Coordinación Ecológica Área Metropolitana Sociedad del Estado* (CEAMSE) was created by law 8894/77 and in 1978 another law (9111/78) required all AMBA municipalities to send all their MSW to CEAMSE sanitary landfills, the only permitted MSW destination. This led, in 1978, to the establishment of a basic infrastructure of MSW management for AMBA that replaced open dumps and incinerators with authorized landfills but banned reduction and recycling programs.

A big step in solid waste management in Argentina was achieved by the passing of the “Integrated Solid Waste Management Law” (Ley Nº 25.916). It established responsibilities for MSW management and the principles of source minimization, prevention and precautions.

City of Buenos Aires (Ciudad Autónoma de Buenos Aires, CABA) has enacted a law on MSW management in 2007, called “zero waste law” (Ley 1854), setting the obligation to increase recycling rates and reducing amounts of waste disposed in sanitary landfills. This act enforced local administration to fulfill targets for this reduction from 2010 to 2020 according the following scheme showed in Table 1. Finally, it is prohibited the final disposal of recyclable and useful materials in 2020. Unfortunately, this law is not actually fulfilled and according official records amounts of MSW to final disposal measured and estimated are not only decreasing but they are increasing it as can be seen in Figure 2 until 2013 (GCBA, 2016). This tender has changed in 2013, when two treatment plants were erected and began to reduce the amounts of MSW to final disposal.

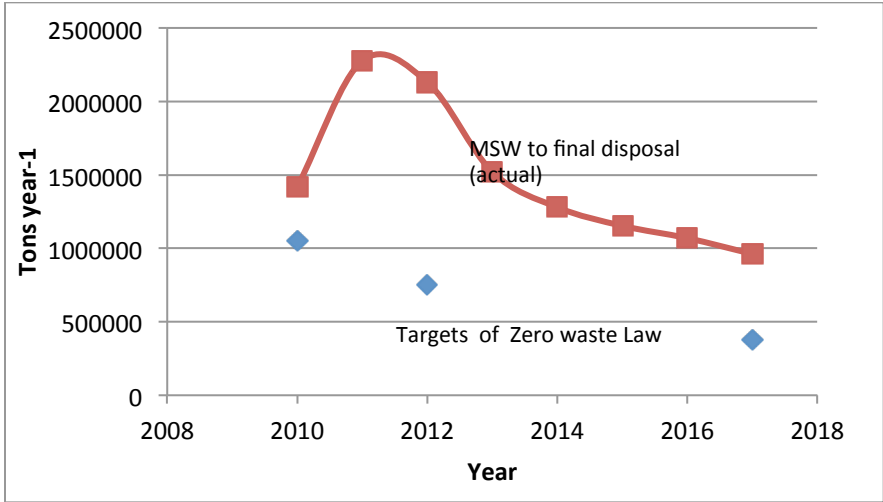


Figure 2: Comparison between actual MSW amounts sent to final disposal from CABA (squares) and targets of zero waste law (diamonds).

GCBA and some municipalities have implemented source separation programs with street waste containers for dried (or recyclable) wastes like papers, glass, metals and plastics and containers for trash or wet wastes (food wastes, others).

Another remarkable restriction enacted in this CABA law is the prohibition of MSW combustion in all its ways (with or without energy recovery) in CABA and it is also banned contracting services that use MSW combustion in other municipalities.

Until 2013, treatment technologies are limited to material recovery facilities (MRF) and composting of yard wastes. In existing MRFs, recyclable wastes are separated manually, baled and sold to industry and refuse streams are sent to landfills. Each of these facilities processes not

more than 100 ton day<sup>-1</sup> and, due to low participation in source separation programs, efficiency is very low, nearly 10%.

The growing cost of waste treatment and final disposal, together with rules that incentivize the use of new technologies to reduce contamination, have been the deciding factors that have led to erect new treatment plants that began to operate in 2013. One MRF has been inaugurated in January 2013 in Norte III complex using mechanical biological technology (MBT) to treat 1000 ton/day of MSW from CABA in order to reduce amounts to final disposal.

Another of this treatment plants is the CDW treatment plant located in the south of CABA, with an initial capacity of 1,000 ton/day but it has been rebuilt and its capacity is now more than 2,000 tons day<sup>-1</sup>.

As city of Buenos Aires has no land to dispose its MSW, most of them are sent to CEAMSE landfills creating additional final disposal costs for their citizens while less than 6% is recycled in its four MRF. Municipalities where landfills are located (San Martín, Tigre and San Miguel) always demand CABA to reduce MSW amounts to final disposal as an expression of nimby (neither in my backyard) effect. There are only three authorized sanitary landfills in operation in AMBA (Figure 1), all three managed by CEAMSE. All these landfills face great social opposition due to truck traffic, noise, odor and health problems occurred during previous operations.

According to this description of current MSW management in the study area, it is clear that it relies on disposal of MSW in sanitary landfills and investment in new waste treatment infrastructure is necessary to meet the targets of city of Buenos Aires “zero waste law”.

Despite efforts in reduce MSW generation; there is no data in Argentina about the CDW reuse rate. While countries such as The Netherlands, Denmark, Estonia, Germany and United Kingdom have rates upward of 75%, in others, including Greece, Portugal, Hungary and Spain, the rates are under 15% (Rodriguez et al, 2015). The Argentina CDW recycling industry is rather newer than in other countries such as in UE, whose longer recycling tradition can be attributed to certain intrinsic characteristics (want of natural resources, specific legislation, institutional support, social awareness) that directly or indirectly, encourage recycling. The key reasons for Argentina's low recycling rate (6%) include: a) paucity of highly specialized recycling plants; b) low demand for recycled materials; c) abundance of natural resources; d) lack of control of unauthorized landfills; and e) low taxes on depositing waste (PAHO, 2011).

The present study analyses and assesses the management model prevailing in City of Buenos Aires CDW management system to identify its strengths and weaknesses. It addresses the type of facilities in place; governmental involvement; processing plants' management model, geographic location and area of influence; origin of CDW classification of incoming waste; and destination of rejects.

## **MATERIALS AND METHODS**

A qualitative methodology will be applied making identification of stakeholders in the management of CDW and semi -structured interviews to them. Based on the results of interviews and literature search, field visits were made to the CDW treatment plant of city of Buenos Aires, offices and laboratories of stakeholders. Results were processed and recommendations were made.

## RESULTS AND DISCUSSION

### 1. Identification of stakeholders

The following stakeholders were identified in the management of CDW in CABA, namely:

- Construction companies of CABA that generate CDW. These actors are mainly grouped in the Argentina Chamber of Construction.
- Professional Council of Architecture and Urbanism, which brings together architects and landscapers enrolled in CABA.
- CDW collection and transport companies that are headquartered and / or provide services in CABA. 36 authorized carriers that perform the collection of the recipients of collection of CDW were identified. They are private companies that supply containers (of 3 to 6 m<sup>3</sup> capacity) to generators and once they are complete, the CDW is removed and transported to the treatment plant.
- CABA Government, through the Ministry of Environment and Public Space which is responsible for the CDW treatment plant and Control Agency which controls the carriers.
- The company operating the CDW treatment plant of CABA.
- National Institute of Industrial Technology (INTI), which has a team of research and development of construction materials and studies about the reuse and recycling of CDW.

### 2. Interviews with stakeholders

The results of the interviews are presented.

#### 2.1. Argentina Chamber of Construction (Camara Argentina de la Construccion, CAC)

According to members of the Argentina Chamber of Construction, the composition of the CDW, varies depending on the type of infrastructure concerned and reflected in its major components, type and percentage distribution of raw materials used by the sector. Materials in CDW depend on a much wider number of factors such as the local climate factors, the purchasing power of the population, the uses in the building, constructive habits, etc.

On the other hand, the CDW composition of the buildings varies over time and thus also changes its composition, depending on the age of the building or structure that is under demolition. Figure 3 shows a possible distribution of the volume percentage of the various raw materials used in the construction.

According to the global trend and widely applicable in the European Union towards a massive recycling of CDW, a possible grouping of the CDW in Argentina it could be made based on its composition, relating to matters such as selective separation, collection and selective demolition and also the characteristics of some hazardous materials.

In this sense the CDW could be classified into:

- Inert CDW justifying separation and selective collection in terms of economic value they represent. Some methods of washing, separation and crushing should be economical on energy.
- Hazardous CDW and potential hazardous CDW to the environment.

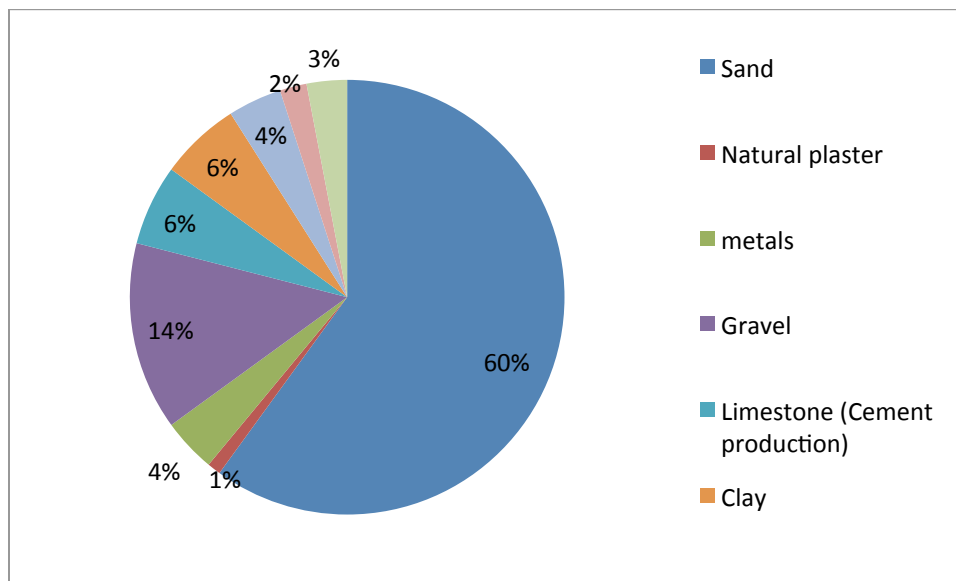


Figure 3: Distribution in percentage in volume of raw materials in CDW. Source: CAC, Dec. 2015

Currently metals have a resale value well established. Materials like tiles and bricks have a considerable demand. The same is true of the refractory bricks that are mostly recyclable for production of new refractories. In turn, the classification of waste can also be according to their origin, which makes it more difficult collection and selection, including classifications can be distinguished:

- Demolition Waste.
- Construction Waste (Reinforced Concrete Structure, Masonry, wall and floor coverings)
- Excavation waste.
- Inert Waste: non-hazardous waste that does not experience significant physical, chemical or biological transformations.
- Hazardous (potentially hazardous to health) Waste
- Waste banal (similar to household waste).

## 2.2. Professional Council of Architecture and Urbanism (Consejo Profesional de Arquitectura y Urbanismo, CPAU)

This council brings together architects and planners who design and run construction sites in CABA. This council has a Sustainability Manual in Architecture 3 (Schwarz, 2016) which includes recommendations on the management of CDW in the works. This manual is voluntary for professionals and was developed by the Subcommittee on sustainable construction of CPAU directed by Architect Andres Schwarz. This manual gives guidance of how to separate the CDW generated in the works, and its possible reuse in the work and how to give final destination to CDW.

According to architect Schwarz, waste management within the construction work begins with identifying recyclers according to the urban context of it. That is, which entities can recycle materials or receive them as a donation and then plan the removal of material to be recycled.

Since Architectural studios and Construction Companies began applying **LEED** rules (Leadership in Energy & Environmental Design), a new role is created in the field of construction: environmental management professional in works, with the agreement of the construction management.

The functions of this professional are:

- Designate an area for collecting waste, preferably close to the main entrance of the construction work. If the construction area is very extensive, either vertically or horizontally, intermediate stations for the collection of waste will be disposed.
- Supervise construction manager (representative of the construction company), which provide for recyclable waste baskets, indicating at least: paper and paperboard, metals, wood and plastics. Depending on the amount of recyclable material may be adopted plastic baskets with wheels and lids, dump trucks or barrels of 200 liters.
- Designate a special place for "demolition debris" because they can be used for fillings of construction and / or temporary circulation roads, as long as they are not contaminated (e.g. asbestos). If the tender specifications allows or promotes, they may be used as coarse aggregate or fine aggregate concrete poor plastering.

Architect Schwarz informs us that the collection of debris should be separated from the rubble of natural terrain, would otherwise not be used for poor concrete or plaster. The collection will be available in small volumes in tippers, but in larger volumes will be arranged on the ground a plastic blanket 2 meters protruding base of the mound, thereby contaminant infiltration material comes from natural ground is minimized.

Finally, he said that to apply to credit Waste Management regulations LEED, once a month or the period of time specified by the tender specifications, the head of GAO deliver a spreadsheet showing all waste generated, broken down by type (rubble, metals, plastics, etc.), where attention will be paid to the computation of m<sup>3</sup> (cubic meters) of recyclable waste have been recovered in the same construction work (debris) or other municipal, provincial and / or national entities.

In addition, a dispatch note will be delivered. The waste generated are declared on it, also they are broken down by type, special waste (chemicals, especially paintings) and hazardous waste, calculated separately.

It also clarifies that the waste that comes from pruning and earthworks are not counted as construction waste.

Here is an example of the dispatch note with the necessary data. It also contains a classification of waste carried out by the construction companies to apply the LEED rules credit can be seen in Figure 4.

Schwarz concludes that while LEED standards are voluntary, the construction business increasingly requires its implementation and the realization of a draft law that become mandatory for all Argentine territory still needed.



Waste management		
Waste generator data		
Company		
Responsible for		
Contact telephone		
Data of the waste carrier		
Company		
Name of driver		
Driver's ID		
Contact telephone		
Destination of waste		
Data from table waste handler or receiver		
Company		
Responsible for		
Contact telephone		
Destination or type of waste treatment		
Description of the residue	Mark X	Volume
Rubble		
Wood		
Plastic		
Iron/metal		
Cardboard/paper		
Glass		
Organic		
Mix		
Other (specify):		

Figure 4: Control dispatch note for the reception and transfer of materials

### 2.3. CDW collection and transport companies

Most companies transporting CDW from the works to the treatment plant of CABA are small companies with containers of 3 to 6 m<sup>3</sup> of sheet metal. They leave the containers in the works for a day or two days and then retire full. These containers should have adequate signage as they are generally installed in the streets and avoid the inconvenience to vehicular traffic. These companies are controlled by the Control Government Agency of CABA (Agencia Gubernamental de Control del Gobierno de la Ciudad de Buenos Aires).

### 2.4. Government of the City of Buenos Aires (GCBA)

The interview with Jorge Wilkinson, Chief Operating Officer of CDW Treatment Plant, depending of Direction of Treatment and New Technologies, Undersecretary of Urban Hygiene of the Ministry of Environment and Public Space was very important and findings have emerged.

Referring to ordinances, resolutions, etc. of the city on the management of CDW, he reported that there is currently no specific law governing that citizens should separate construction waste. There is only one ordinance, which is No. 33,581 currently in effect, which states that it is prohibited to

throw or maintain any kind of waste on public roads. It also makes a reference to who use concrete, removal and the remains of it should be poured onto the surface of the work or in a suitable container for later retirement (in this case refers to tippers o container). In addition, it refers prohibiting these remains are thrown into the streets, sewers or sidewalks.

Also, this same ordinance and Ordinance No. 41653 focuses the removal of these bulky waste, are borne by the user. Resolution No. 115/1995, currently in force, provides that Control Services Division, under the Directorate General of Environmental Sanitation and Urban Hygiene (currently nose if exists or has changed name) is responsible for informing control behavior of neighbors, as regards the disposal of waste and throw and improper treatment of them, in respect of household waste, exposure was day or time; debris; etc.

In relation to the regulation of carriers of CDW, it is relieved that there is no legislation requiring them to carry CDW on the particular plant, but they are responsible for the waste. Therefore they have to find appropriate site of treatment and/or disposal. In CEAMSE landfills, which is the alternative to dispose CDW, they are charged for disposal, whereas in the CDW treatment plant in CABA (called Varela) is granted free service. Therefore they found convenient if the distances warrant.

On the other hand, another motivation for CDW transport companies is that many construction companies require them that to arrange CDW in a place where it should be recycled so the buildings can add scoring in LEED standards (US Green Building Council, 2016).

CDW collection and transport companies have to be registered in the category of dump truck. In the CDW treatment plant, CABA gives a free service to the dump truck, control the entry and check that they have vehicle verification and enabled secure.

Regarding the control of CDW generators, it exists in CABA a Register of demolition companies. Each demolition work has a Technical Represent, who is responsible for overseeing the work and take the necessary measures to prevent cave-ins, landslides, damage to boundaries and any other damage that may cause the excavation. In case an excavator or demolition company wants to change technical representative, it must re-submit a documentation attaching new representative form. It is forced CABA Act 4268 which provides for the mandatory inspection of all construction site during excavation and demolition stages applies (Resolucion 22/2007, 2007). The responsible agency is the Ministry of Security through Government Control Agency, and in particular the Directorate General of Supervision and Control of Works.

## **2.5. The company operating the CDW treatment plant**

For this interview, CDW treatment plant located in the southern neighborhood of the CABA (in Varela and Ana Maria Janer Avenue) was visited in April 2016. One of the officials, Eduardo Franchi, of company EVASA (member joint venture that has the concession of operation of the UTE EVASA and Cascotera Velez Sarsfield) plant. This plant processes between 2,500 and 3,800 tons per day of CDW. It operates 6 days a week.

This plant is owned by the Government of City of Buenos Aires, and it has been commissioned to the joint venture operation mentioned by 20 years. The concessionaire charges the GCBA per ton of recovered CDW. Therefore, all trucks will also weigh on departure.

The operating circuit of the plant consists in the following steps. Control entry and weighing of trucks. CDW enters the plant in trucks with dump or open flatbed trucks with canvas cover. The

trucks are licensed by the City of Buenos Aires that has registered. None truck from Buenos Aires Province is received. In the control of entry, trucks are weighed and visually inspected its cargo. If they contain green waste, they are derived neighbor pruning waste plant. If you have mostly municipal solid waste, it is derived CEAMSE transfer plant. Weighing the truck is also indicative to verify containing mostly CDW. If it is light, suspected and inspects better because it can have residues not allowed as cans of paint, asphalt membranes, etc. Nor sludge or liquid waste such as cleaning the rivers and draining are received. Trucks coming from excavations that contain mostly soil are referred to the landside storage. CDW trucks are derived aggregates plant. CDW trucks are referred to a discharge site which is next to a high discharge ramp in a hopper that feeds a first trommel (separation by size and density). Fine materials fall (mainly soil) and are collected as soil. Magnetic separation: CDW ground free pass through a magnetic separator which retains ferrous metals. Separation of light material: CDW passes through a wind tunnel where light plastic and paper are separated. Manual Separation picking conveyor belt. CDW is driven by this tape where operators separate plastics, glass and remained metals in a covered and enclosed area to avoid exposure to particulate matter. Shale and grinding jaws. CDW is separated by size in sieve, are then milled in jaw crusher and again sifted to obtain the different fractions to recover: thick rubble, pure rubble, rubble 12 pellets, fine rubble, rejects to CEAMSE (10%), Paper, plastic, iron. Soil has no commercial value but is sent to CEAMSE for use in covering landfills. Weighing truck to the exit. Trucks with recovered materials are weighed and the output value is recorded.

## **2.6. National Institute of Industrial Technology (Instituto Nacional de Tecnología Industrial, INTI)**

INTI has an area called INTI-Building, Environmental and Applied Geology and performs research and development on construction and demolition materials.

In this regard it was found the following information: in the plant producing concrete, it is normal to use between 15 and 30% of CDW material of known origin. There is an association of companies that elaborate concrete in Argentina and there are 2 plants using these materials. In national standards, it is not accepted crushing aggregates from CDW for concrete. Overall for use, recycled materials from CDW need to be previously saturated because in general they are porous aggregates that are not appropriate. Sometimes water washes are performed to the aggregates, and then this water is used to prepare the concrete. It exists in all cases, the restriction that the materials from the CDW may contain no more than 500 to 1,000 ppm of organic matter because this destabilizes construction materials.

As for the fine and coarse aggregates recovering from the CDW, it would be analyzed to verify its properties such as particle size analysis, durability attack with sodium sulfate; petrographic examination of aggregates for concrete, organic matter, fine material passes IRAM 75µm sieve, carbonaceous materials, and reaction alkali - aggregate. I accelerated mortar bar method, friable lumps of clay and particles, sample preparation, soluble salts and sulphate, chloride.

## **RESULTS ANALYSIS**

The CDW recycling sector is very new in City of Buenos Aires so there is not any business group in this activity. The only company operating the CDW plant is a joint venture created specifically for that purpose.

As there is no recycling target defined for CDW in CABA, the actual recycling of CDW is today counted in the target of total MSW for CABA. The high efficiency (90%) of material recovery in

CDW plant has contributed to reduce amounts of MSW since 2013 in CABA. There is only one CDW processing plant that was built by the government and then was commissioned. The start-up date for the plant was 2013, a clear indication that CDW recycling is a relatively recent business in CABA and there is not an industry group on CDW recycling. It is expected that the number of companies engaging in CDW recycling will grow gradually in next year's due to the construction industry reactivation demanding sustainable CDW management for LEED certifications.

CDW facilities in CABA is a stationary one, i.e. recycling plant located in an enclosed site authorized to recycle CDW using fixed (essentially crushing) equipment and conducting no off-site operations; and it was not reported a mobile facility with mobile recycling machinery and equipment. The model that was found in CABA is privately operated government concessions. The level of government participating in CDW plant management involves in the case of CABA is a local agency.

The type of government intervention is mainly in these activities: inspection of the processing plant by environmental authorities, participation in plant management, subsidies and support for recycling or other types of intervention, including: a) incoming waste control, b) monitoring in-plant waste management, and e) keeping a register of waste managers.

The recycling plant can simultaneously accept CDW of different origins (worksites, landfills, industrial CDW plants). Incoming construction waste is not classified essentially on the basis of how clean it is and the materials it contains. The final destination of plant rejects is municipal/regional landfills.

## **CONCLUSIONS**

The present study analyses the present CDW management system model in City of Buenos Aires, Argentina in light of its impact on the technical and economic viability of using the end product (recycled aggregate) in new applications in construction (structural applications) and hence capitalizing on the economic and social benefits to be reaped.

It is necessary to establish a new legislation that defines the obligations of all the actors involved in construction (developers, builders, waste managers, environmental authorities and all levels of government, particularly local) to implement all necessary measures to generate less CDW and reuse, valorize and suitably manage such waste. The most prominent of these measures include: mainstreaming CDW management plans in detailed building designs, new fees, assignment of sites for the installation of management infrastructure (such as recycling plants and transfer stations).

The profile of a typical CDW treatment and recycling plant that can be drawn for the present findings is as follows. The private initiative behind companies has construction industry but not specific waste processing experience. Recycling facilities are stationary, operating from a permanent site. Recycling is a relatively new industry in Argentina, which began in an informal way and done by scavenger's cooperatives. Government intervention in this activity companies consists primarily of environmental inspections. CDW processed is sourced directly from worksites. Rejects are generally deposited in (on-site, public or private) landfills. Incoming CDW is not classified as clean, mixed or dirty.

CDW management in CABA is facing significant challenges as: lack of CDW regulation, lack of control of illegal landfills, substantial interregional differences in deposit fees, and absence of legislation on the use of recycled aggregate. The present management model needs to be

improved, with particular emphasis on enhancing the government's role: active enforcement of environmental laws, furtherance of the use of CDW as a raw material in the manufacture of new materials and compliance with its own recycling targets.

#### **ACKNOWLEDGEMENTS**

This research was funded by the Argentine Business University (Universidad Argentina de la Empresa) under project AyCT C16T01. Authors want to acknowledge the collaboration of interviewers and authorities of Government of City of Buenos Aires, Argentina.

#### **REFERENCES**

Elias Castells, X. (2009). *Reciclaje de residuos industriales: Residuos solidos urbanos y fangos de depuradora*, 2ª Edición, Ediciones Diaz De Santos, Madrid.

Pan American Health Organization (PAHO), Interamerican Association of Sanitary and Environmental Engineering (AIDIS) and Inter-american Development Bank (IDB), (2011), "REGIONAL EVALUATION ON URBAN SOLID WASTE MANAGEMENT IN LATIN AMERICA AND THE CARIBBEAN - 2010 REPORT", Washington DC.

INDEC, Argentina National Institute of Statistics and Census: <http://www.indec.gov.ar> and [http://www.indec.gov.ar/uploads/informesdeprensa/isac\\_05\\_16.pdf](http://www.indec.gov.ar/uploads/informesdeprensa/isac_05_16.pdf) Indicadores de coyuntura de la actividad de la construcción, mayo 2016, (accessed June 2016).

CEAMSE: [www.ceamse.gov.ar/estadisticas/](http://www.ceamse.gov.ar/estadisticas/) (accessed June 2016).

GCBA 2016 (reporte de cumplimiento de ley de basura cero): [http://www.buenosaires.gob.ar/areas/med\\_ambiente/basura\\_cero/?menu\\_id=30973](http://www.buenosaires.gob.ar/areas/med_ambiente/basura_cero/?menu_id=30973) (accessed June 2016).

Resolution 22/2007: [www.cedom.gov.ar/es/legislacion](http://www.cedom.gov.ar/es/legislacion) (accessed June 2016).

Schwarz, A. (2016), *Sustentabilidad en Arquitectura 3: Análisis y Compilación de las 100 mejores prácticas y procedimientos de sustentabilidad en la Producción de Obras de Arquitectura*, CPAU, Buenos Aires.

US Green Building Council, 2016, "LEED v4 for BUILDING DESIGN AND CONSTRUCTION" [http://www.usgbc.org/sites/default/files/LEED%20v4%20BDC\\_04.05.16\\_current.pdf](http://www.usgbc.org/sites/default/files/LEED%20v4%20BDC_04.05.16_current.pdf) Updated April 5, 2016, (accessed June 2016).

Rodríguez, G., C. Medina, F.J. Alegre, E. Asensio, M.I. Sanchez de Rojas (2015), Assessment of Construction and Demolition Waste plant management in Spain: in pursuit of sustainability and eco-efficiency, *Journal of Cleaner Production* 90, 16-24.