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A Review of Sustainable Building Materials in Green Structure Environments

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Abstract
This paper presents the important review of sustainable building materials in green structure environments. To provide energy consumption and large amount of natural resource, the materials of construction utilized in the structure sector have accounted in this time of researcher's interest. Over three decades, the green structure has developed regarding to administrate and technological advance for building sector to provide energy sustainability and resource. Hence, the development of green building materials plays vital role in this field due to the energy and sustainable resource contribution. The development trend and wall materials study of thermal insulation has realized the barricade of power and resource operation on green structure. A review of recycle wastes and plant fibers is improved to illustrate the function of green building materials and sustainable growth throws in advance. The barriers from business and challenges, policy aspect and technical tasks are reviewed properly. In addition, prediction and viewpoints of green building materials life cycle construction are investigated. The review of walls material importance and heat lagging materials from top of observation of resource and energy spending are present and discussed properly in this paper.

Keywords: Building Materials, Green Structure Environments

1. Introduction

The building manufacturing offers a quantity of service opportunity direct or indirect and endorses the growth of economy in urban treatment in any country [1]. Multi billions plenty of carbon production and consuming a roughly one third of worldwide water and energy in the year will cause by buildings in the 2030s [2-10]. Hence, the building already had insignificant impact on the resources of surroundings [11]. Though, buildings construction and materials production will lead to 50% of all emission of pollution and black carbon of about one-third [12, 13]. The institutional and commercial building numbers in 2050s will three time that in 2010s [14]. In United State and European Union, the building section accounts of energy consumption for 65% and 42% respectively [15]. Additionally, depend on the information of environment admin, the carbon dioxide emission from building section explanation for approximately 35% to 40% of whole gas emission in united states and Europe [16]. Not only products multitude include in the building sector, but also biological nutrients and technical have a significant collision on energy cycle, water, flora, air quality, fauna and economic social factors [17-20]. The construction resources increasing could lead to emission, pollution and emphases the requirement for power and resource protection to provide sustainable improvement [21]. The structure environment become more obvious associated with building activities impact and the action of green structure become more frequently implemented [22-23]. To the maximum extent, the green structure saves the resource, energy, land, water and materials, consequently as to guard the situation and decrease the toxic waste in the life sequence of the structure [24, 25]. In some field, the sustainable and high-performance buildings required green structure [26]. Subsequent to green building appearance, many countries have set up applicable guarantee standards to achieve better standardized of green building development which develop the environment of the human living [27]. Depend on the examiner system, the green structures are intended with innovative properties of green power economy and promote the improvements of materials cycle with indoor air development materials [28-29]. As a result, green building should offer less emission, waste, power and be valuable to the people even as keep maximum excellence [30-34]. The construction materials in the structure are the majority significant section which is straight exposes the human. The quality and source of construction materials will pressure inside surroundings and building charge [35]. During the construction progress, the employ of green building materials is an inventive key for resource saving and energy [36]. Thermal isolation and wall resources are the major mechanism in the structure and price huge resources amount [37].

The objectives of the majority investigate at green building are fewer worried with green building resources. Employ of green construction engross overall aspect of structure except the preceding researchers mostly contain water proof seal and decorative materials. Thermal insulation and wall material are most important materials in the structure but they are communicating evaluation by academics. Many plants fiber is suggested and their perfunctory property and building squander are evaluated with many reprocessing ratio. In the construction field, the nonconductor equipment is separated into photo chromic glass and insulation materials which innovative technologies. In this work, the information integrates in conditions of fabric property and situation of use and viewpoint prediction are discussed and summarized.

2. Green building development

The research results analysis on website of science was carried out on 2019 by the green building materials word. The data includes thousands of records which consist of mainly articles, reviews and meetings since 1981 to this time. Fig 1 illustrates the research connected to green building fabric which is augmented faster following 2000. The three main publications are in English, Korean and Chinese. Table 1 shows the pinnacle seven journal with the majority of publication in construction and building material, advanced materials research and applied mechanical materials with more than hundreds records for each. In 1969s, the environmental structural design was urbanized by Paolo Saleri which is a designer from Italy. In the meantime, the intend with natural world book was printed by Ian L. McHarg in 1969 that is observe as a founder of biological building and the green structure idea. In 1970s, the oil disaster pushed the human to facade the danger of major normal property expenditure from building industry. This is ended the human to think put onward sustainable expansion in building tasks. In 2007 and 2004, the rate of increasing reaches around 68% and 75% respectively as illustrated in Fig 1. This will lead to believe that the internal force in the works like enforcements and creation of policies by government concern.

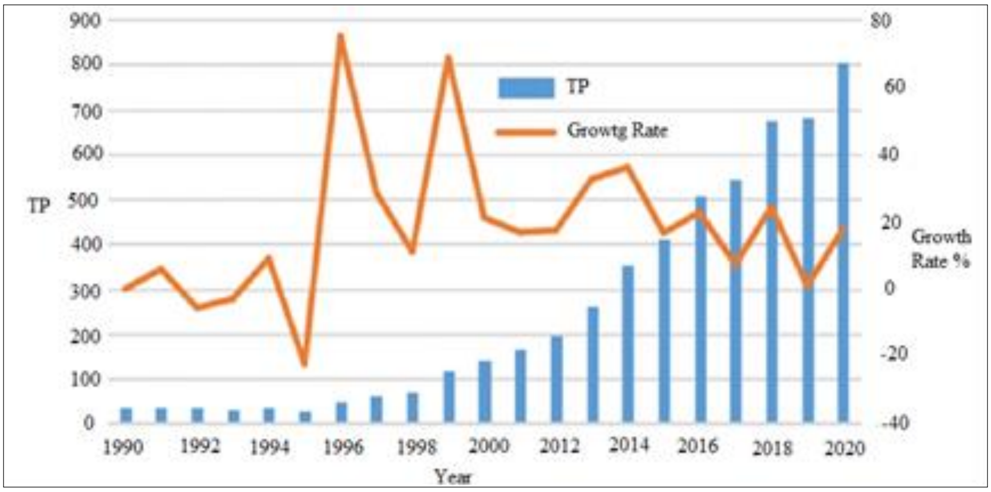

Fig 1: Article publishing numbers per year

Table 1: Top publish source in relevant paper

Numbers	Publication source	Records	Percentage
1	Applied materials and mechanics	112	3.11
2	Building and energy	63	1.8
3	Green building	33	0.911
4	Civil engineering materials	29	0.822
5	Research of clinical rehabilitative tissue	25	0.722
6	Review of Renewable sustainable energy	24	0.65
7	Sustainability	19	0.53

Green building refers to application of progression and structure which are environmentally accountable and resource efficient during building cycle from setting up to design, construction, operation, preservation, renewal and destruction [38]. The 3R which represent (reduce, recycle, reuse) principle should proposed by architect to decrease the employ of not renew resource and energy in order to keep and decrease the power or decrease the collision respectively on the situation [39]. As far as possible, to use again structure mechanism or products and to strengthen the old building restoration and to reuse some of components were used before. The research of green structure has turn out to be significant to take into description for comfort and environment [40]. In architectural development, a lot of country has implemented promotion and practices of green building which play a vital function in this process. In 1997, Kyoto protocol has proposed and initiated from 2005 as first time in person times gone by greenhouse gas emission. This protocol proposed a technique to control the power consumption and anthropogenic emission which is reduced by 5% from those in 1990 via duration from 2008 to 2012. The reduction of greenhouse gas emission in the global is started when the donation of COP 15 detained at Denmark in 2009 when hopeful the residential country to offer monetary hold to develop and prepare the housing policy. In 2010, the Denmark agreement came into force to create the idea of green building sensible. The urbanized country recognized the green structure ranking system to become accustomed different individuality about the globe in the duration beginning 1990s to the end of 2005s [41-60]. The score system could be quantitative describing the energy and water saving efficiency. The environmental impact of greenhouse Gas emission reduction is evaluated by the performance of 3R resources and financial settlement to offer a choice creation foundation for designers and policy makers. The needed items have paid more attention and filling materials, wallboard, textile, hard pavement, surface materials, doors, insulation, concrete, ceramic, widows, ceiling, caulking and sound absorbing. The argument in excess of the ecological impact of structure materials is predictable except it can direct sustainability principles to decrease the whole impact [61]. Evaluation of building materials criteria consist resources management, pollution, indoor environment quality, performance of comfort [62]. Khoshna L. F. proposed a replica bearing in mind reserve competence, water conservation, inside air excellence, efficiency and affordable [63]. A guidance of environmental design and power is comprehensive assessment system for structure environment efficiency in USA and Japan, respectively. In addition, there is a building research establishment environmental in UK and many other standards in Germany, Australia, Norway and France. Based on sustainable criteria, the use of materials could be directly decreasing the environmental loads from building materials [64]. In this time, the chosen of fabric and low in person power, pollution, waste manufacture, power spending will influence financial and communal scope for sustainable [65]. Hence, the operation of green building materials is regard to possible path and minimizing the ecological and impact [66-67]. The green building is a type of structure fabric that required the subsequent conditions:

1. Huge quantity of using the agricultural, manufacturing, or civic solid dissipate product.
2. The specifications of free contamination, human health, and ecological production.

This paper introduces a review and discussion of thermal insulation and wall materials which is refers to solid waste and cement reinforcement materials. The ramparts are the major arrangement of the building and stand the heaviness but it's in addition it performs as a quantity of heat and noise insulation. During the construction of whole building, the walls resources guide to an enormous price, except it will keep much green methods. This section, the walls material for mass manner purpose is initiate in the following features [68-70]:

1. Green resources for cement strengthening
2. Used ravage structure resources

2.1 Concrete reinforcement of natural fibers

The universal word for engineering compound resources paved by cementations resources is the concrete which is achieved by strengthen fabric, collective and irrigate beneath moving environment. The cement concrete has many benefits in engineering materials such as high compressive strength, low cost, durability and high plasticity. Additionally, this production of concrete is used with big amount of fabric resources which bring grave side belongings on the people live environments. The concrete materials bring a harsh analysis to sustainability improvements and the employ of this material admixture could be extremely accepted at abroad and home. To substitute a fraction of cement that reduce the environment of pollution, a grinding slag, recycled aggregate and fly ash are mixed into concrete. Hence, there are a lot of investigations and researches on the plan fibers as cement reinforcement are introduced in all over the world [71-75]. The acceptable properties of piassava fibers prove that the possible employ in wood artificial compound [76-78]. Table 2 illustrates the green materials property for cement strengthening types.

Table 2: Green materials properties for cement

	Density	Tenile Strength	Young Modulus	Moisture Content	Micro-Fibrillar Angle	Cellulose %
curaua	1.4	630	40	NA	NA	70
coir	1.1	85	4	9	40	40
flax	1.4	900	28			
Ramie	1.5	700	62	12	8	70
abaca	NA	600	NA	8	NA	60
oil palm	NA	NA	0.5	NA	45	59
cotton	1.6	NA	9.5	8	NA	87

In mortar composites, the water retted thread has employ as strengthening [79]. The routine property of many cement strengthening resources illustrated in Table 3 explain that the natural fibers have same modulus with high strength than glass fibers [80]. The distribution of fiber density is exhibit 1.3 to 1.6 g/cm^3, at the same time as the power of youthful module and tensile diverge amongst diverse thread. Less thermal conductivity in the plant fiber wall material compared with additional resources and has high heat insulate effects. The major characteristic is the shrinkage of concrete and good influence on the concrete performance. The plant fiber could restrain the development of concrete cracks as reinforce materials of concrete. Here, the fracture width is 1/3 narrow compared with normal concrete [81-85]. In the tangible, much degree of micro crack is that contain good pressure on the spit tensile potency and flexor potency of concrete. In case of consistently add the plant fibers to the concrete, a thread survival will decrease a micro-cracks expansion with compensate inner concrete imperfection. Plant fiber and medium work is used jointly to get better the tensile, winding, tiredness strengths of the tangible while a concrete receive an outside strength. Fiber wrap in a cement turn into a thick and unruly dispersed network strengthening scheme when the concrete is solidified to increase the toughness and all strength of concrete. The fiber crossways the cracks could stand a convinced weight under the action of load which enhances the concrete ultimate strain capacity. The fiber absorbs high energy when the concrete is impacted which effectively decrease the result of intense pressure and prevent the cracks extension and enhance the concrete impact resistance [86-90]. The investigate into plant fiber mostly focus on the physical and mechanical property of the fiber and the plant fiber corrosion problem in the cement alkaline environment difficult to ignore. Hence, to process the fibers before adding to the cement, the study of corrosion should be investigated. The commonly used methods to overcome the corrosion are the drenched in acid solution and change a fraction of cement and fly ash or silica fume. Another problem of expansion happens in case of shrink and wet at what time dehydrated for plant fibers that influence the connection degree between concrete and fiber. To get enhanced fiber function, better bond resources required to be created which is easily absorbs water in the concrete mixing process. The plant fiber concrete has been applying to certain mission and high-quality consequences were achieved.

2.2 Materials of recycled waste construction

Strcture materials are employ in the traditional processing of building by mainly compose of wood, sand, burnt and concrete. Hence, in the building construction processing and demolition of building, much waste of wood, concrete and bricks are produced. In case of these conventional building materials is used again efficiently, then one could effectively decrease the building place and the contamination of surroundings. Therefore, to comprehend the reprocess of conventional structure resources, the builder could gather burnt product in the processing of disassembles the structure and relate the collection of these resources to the exterior of wall of building. Hence, the recycle and use again of older resources could be realized efficiently and the construction cans also recycling the wood through construction to be used in furniture or decoration of building. The construction of stone and remaining earth, tank mire, undamaging lifeless waste and industrial sludge are the ordinary waste resources building. In the green resource's usage field, the cloud by recycle in different methods and utilized ration of recycle resources range from (20 to 95) % as explained in Table 3.

In wood recycle resources, the recycled ratio is approximately 92% containing particles board and middle density fiber board and wood furnishings and 20% to 80% in additional recycle resources as mineral. One of the recycle materials is wood recycling with huge probable for recycle techniques which play a vital function in the building of town transportation, enterprise and family, such as broads wood and window, chair stool, floors, shelf and building components. To deal with waste wood, one could be used the wood-based panel processing, manufacturing of carpenter board, processing of composite materials and combustible materials transformation.

Table 3: Recycle green construction materials utilization ration

Green Construction Materials	Recycled Material Available	Utilization Ratio of Recycled Materials
Particle boards	Waste wood or wood waste from wood plant waste	More than 90%
Wooden furniture	Recycled particle boards, recycled MDF, or recycled materials from waste furniture, desks and chairs	More than 90% of the wooden parts
Wood-plastic recycled composite	Recycled plastic and wood materials	More than 50%
Autoclaved lightweight aerated concrete blocks	**(Material A)**	More than 60%
Ceramic tile	**(Material A)**	15~25%
Concrete tile	Coal ash, furnace dust, recycled aggregate and so on	More than 25%
Common bricks	**(Material A)**	More than 40%
Rubber paving block	Reclaim rubber and all kinds of macromolecule material	More than 80%
Compressed concrete paving units	**(Material A)**	20~50% (except for cement)
Granulated aggregate for decoration	Recycled glass, ceramic pellets	More than 70%
Lightweight concrete panels	**(Material A)**	More than 50%

At high temperature of 1100 degree, the glass tiles could be fired with waste goblet, clay and earthenware waste as major uncooked resources. To decrease the dismissal hotness of waste glass, the creating glass phase inside the tiles can be used in this case. This type of glass fired brick is mostly employed and cemented on town infrastructure to stop rainfall collection, redecorate the environment and make waste change into wealth.

2.3 Materials of Thermal Insulation

The thermal insulation section in the building is a vital important for resistance of heat and cold. For insulation function in the building, a lot of materials can use as widely distributing. Photo chromic glass and natural insulation materials are reviewed in this section due to their huge possible for sustainability. In general, the structure lagging resources arrive as of petro chemical constructions, but the materials processing in this case introduce contamination to the surroundings with a lot of harms in the revival and recycle of manufacturing material. From the other hand, a number of the manufacturing materials contain high-quality performance such as formed polystyrene board, rock wool board and extruded polystyrene board, glass board but the natural insulation material provide improved view. In the building reinforcement and insulation structure, the materials could be changed by nearby obtainable fiber and other agriculture waste composites [91]. Many conditions in which stopper was employ for insulation, durability scrape confrontation as raw fabric for sustainable building as illustrated in Fig 2. As clear, pad straw, maize husk, coconut pitch and groundnut shell are the minimum conductive in the middle of the majority of natural material of insulation and less than foam polyurethane [29, 49, 88, 97, 99, 104, 106].

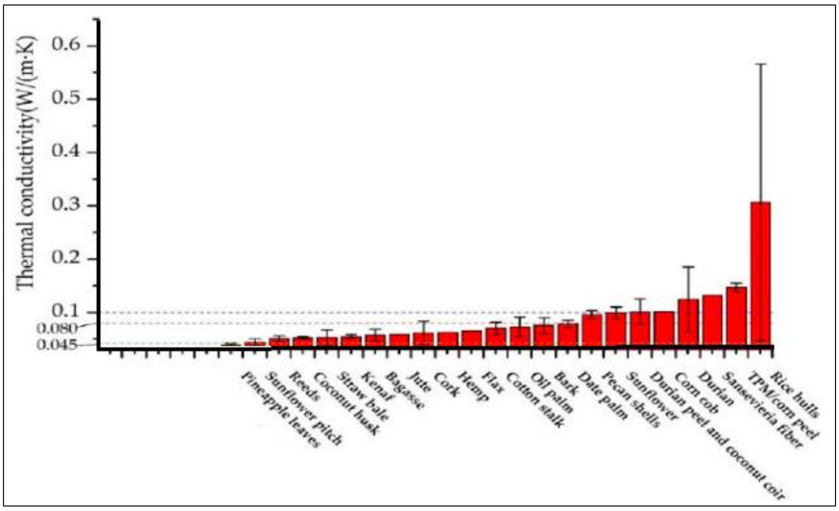

Fig 2: Heating conductivity for many resources

Fibers thermal conductivity in the pineapple is lower than foamed glass insulation board by 0.04 W/m_K and many other normal resources have lesser thermal conductivity than the stage modifies materials. Fig 3 shows the density factor for many types of plant which is clearly shows that the majority usual resources density is lesser than the cement.

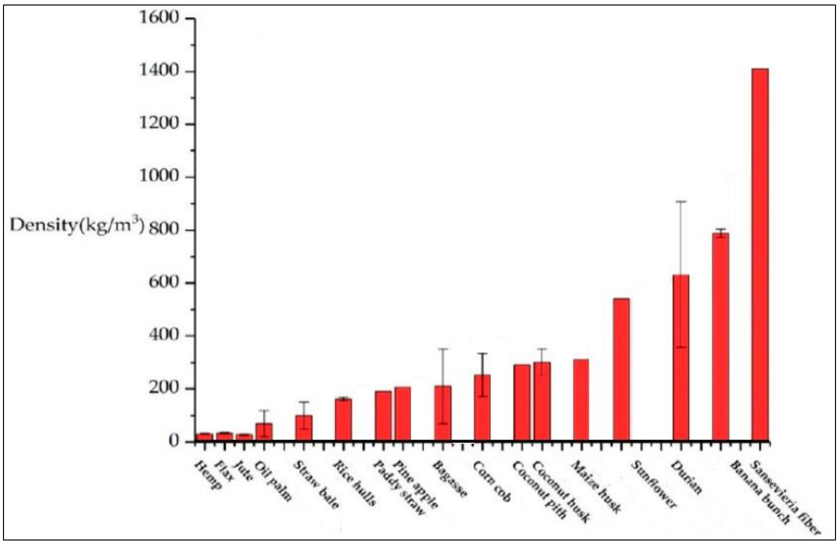

Fig 3: Density of divers usual lagging resources

The natural bark panels have small formaldehyde emission and suitable thermal conductivity [92]. The fiberboard of cotton stalk could be employed as ceiling and wall resources with a small energy and binder [93]. Based on natural fibers, the insulation materials of flax, jute and hemp could exist practical to the building of outside plant wall [94]. Thermal insulation of building can be achieved from date palm wood, corn cob particle board, oil palm, and coconut, sugarcane fibers [95, 96, 97, 98, 99, 100] which is demonstrated satisfactory property for structure insulation structure. For specific application, the particle boards artificial with steamy crop peel utilize as insulating wall and ceiling [101]. With low thermal conductivity, the coconut coir and durian peels proceed as a part of building board [102]. Extreme potential could be offer from rice hulls, pineapple leaves and crushed pecan shells to use as thermal insulation [103].

2.4 Thermo chromic and Electro chromic glass

By the Swedish Grangrist, smart windows were proposed as a brightness adjustment clever tool collected of glass or dimming and substrate resources. Depend on physical situation of electric, light, and warmth, a machine changes its shade condition by fading or coloring response. Hence, it may select reflect or absorb the warmth emission of exterior planet and avoid the interior warmth dispersion to provide the reason of power economy by adjust the indoor temperature and light strength [104-120]. Depending on the diverse excitation techniques, it can be separated into electro, thermo photo and gas chromic that electro chromic has broad marketplace view. The practical resource in the clever window is WO3, TiO2 and VO2 nearby water and dye with aero gel can apply into clever window. The close to infrared reflectance of inorganic materials base window is approximately 25% with higher reflectance is 90%. This type of window required low conversion voltage approximately up to 10V alternative current which could kept transparent throughout the conversion range with adjusted supply between complete coloring and transparent. This type of devices contains of basic glass and electro chromic system with high tenability of transmittance or absorption of electro chromic materials depend on the action of electric field. According to the person wishes, it could comprehend the principle of adjusting the lighting and the electro chromic system selectivity reflect or absorbs the external heat radiation and prevent the loss of internal heat. The energy amount could be reducing by diffusion that building requires to consuming in summer to maintain cool and temperate in winter. Currently, the majority glass resources with this purpose are fluid crystals and electro chromic resources which can be divided in two groups such as organic and inorganic to diverse employ of resources. There are many development directions in the electro chromic field because the conductors and electrochemically stability still require more studies. The trade-off between high charge density and large optical modulation requires be solving and investigating as well and the electrolyte systems needed fast switching window and strong cycle. The photo chromic of inorganic glass is collected of optical responsive fabric and medium class which is additional to medium glass with a bit responsive fabric. It's precipitate as a photo sensitizer in the thaw of glass after heating treatment. Mainly, the optical responsive resources are copper, cadmium halide, silver or unusual earth ions. In general, a bottom glass considers using alkali metal borosilicate goblet as substrate and property of photo chromic are the best class. Due to high thermal stability, strong oxidation resistance and long period of discoloration, the inorganic photo chromic materials are widely used more than organic photo chromic materials. According to the temperature, the thermo chromic glass can change its transparency which is covered by thermo chromic material on the class and regulate the transmittance of glass with the warmth changing. Typically, the thermo chromic materials contain a stage of change warmth and display diverse optical property below or above the stage of warmth change. The stage vary warmth must be approximately room warmth in order to use thermo chromic materials for structure power competence. In addition, there is much type of thermo chromic materials with little room to select which could divided into inorganic, organic, and liquid crystal materials.

2.5 Prospects and perspective

There are still some confronts and barricade to overcome for wall and heat insulation resources. The barriers could be classified into technology, business and lawful rule associated as explained in Table 4 [121-135].

Table 4: Barriers and challenges of green construction materials improvement

Items	Barriers and Challenges
Business related to Barriers	1. The choice of Building materials is usually decided by price rather than enviroments benefits 2. the innovative technology products are expensive 3. the market demand for product is not high 4. there is no good connetivity between different product 5. the popularity of smart window is still low
Technology related to Barriers	1. the source innovation and quality of raw materials 2. the lack of complete information disclosure on technology innovation 3. the source instability and quality of raw materials
Legal policy related to barriers	1. the limitation of statute for innovation technology applications 2. the lack of incentive for innovative technology supplier 3. the lack of implementation promote innovative technology or advance works 4. not in accordance with the constructions or building regulations

The main obstacle of business-related barriers is the short of community acceptance, consciousness and full understanding of the green structure designer that will influence the market requirements. In insulation and wall materials technology, the green building will lead to investors interesting to investment risk due to that the new green materials technology often involves the application with higher technical cost and uncertainly income. More active laws and regulations were required for the employ of plant fiber in the cement reinforcement and wall materials. The major objectives in the wall and thermal insulation materials development process is the resource saving and energy minimization. The researchers have high interest for industrial solid caste to convene the actual requirements in its place of obtainable energy and resource or domestic garbage treatments. Fig 4 illustrates the recycle materials life cycle depend on the necessary need of green structure resources. The power protection has to be personified in the entire production procedure and uses the waste removal of green structure resources. Therefore, continually optimizing the developed procedure of resources and power spending reduction of resources under procedure of production beside the charge of structure materials have to decrease counting heat preservation cost and transportation costs.

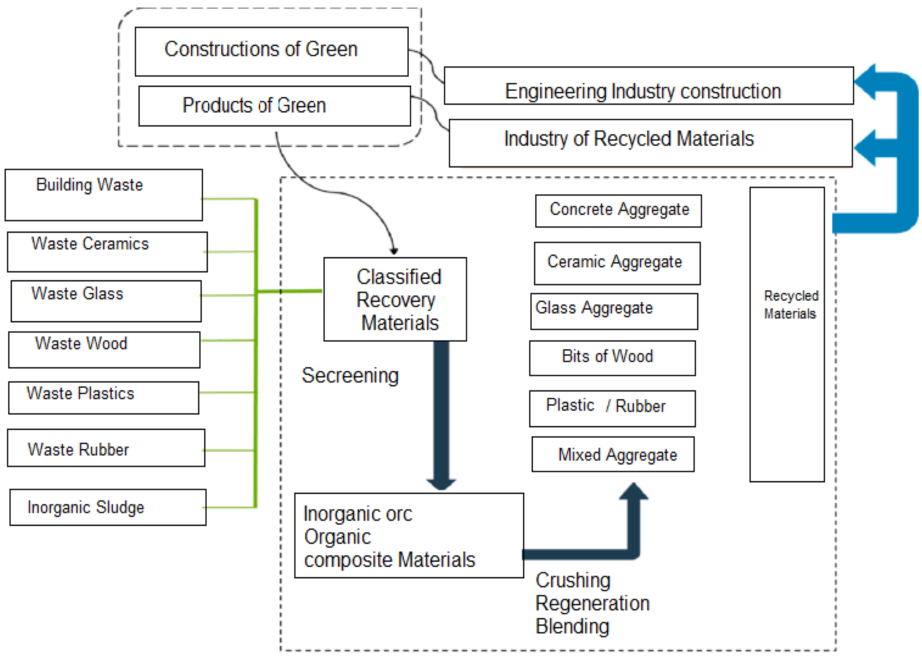

Fig 4: Life cycle of recycled materials

3. Conclusion

This paper introduced the origin of green building and construction materials in details. The green building materials with advance forecast are evaluation as of wall and heat insulation resources. The replacement of green concrete is new power reduction materials that extensively employed in the manufacturing of construction. The construction of recyclable materials is recycled of waste property to provide an environmentally explanation from the waste of construction. The efficient solution for agriculture waste is the natural insulation materials as an excellent performance. The photo chromic glass is a large view to save the energy in cities and offers good indoor setting to health solutions. While the applications and development of green building resources are motionless suffering a lot of confronts. The applications and development of green building resources contain high momentum to sustainable improvements and urban environmental safety. This research planned to conclude the green resources for cement strengthening and recycle waste building resources with two talented green building resources for reduction quantities of power and natural income. The wall materials could create big perspectives in the green methods as basic building structure. In some area of the world, the natural insulation materials have widely used to reduction the charge of wall building via reduction wall structure material. The thermo chromic and electro chromic glass are an inventive knowledge facing charge barriers previous to the application widely. The worldwide endorsement of green building inventive knowledge is compiled a widespread challenges and obstacles counting the lack of community acceptance and awareness. Green building designer is also lack of full considerate and foremost saver for green knowledge associated with industries and speculation risk due to the innovative technology. The strategy of green building improvement has organized as four direction such as policy system perfecting, basic education implementation and partnership strengthen with expansion of monetary incentive to endorse the strategy of objective completion.

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