Hindawi
Journal of Nanomaterials
Volume 2022, Article ID 2682278, 13 pages
https://doi.org/10.1155/2022/2682278

Research Article

Feasibility of the Development of New PVC/Fine Sand Imitation Stone Composite Materials to Promote Rural Urbanization

Yi Wei

College of Art, Shandong Management University, Jinan, 250357 Shandong, China

Correspondence should be addressed to Yi Wei; 14438120050210@sdmu.edu.cn

Received 8 March 2022; Revised 11 May 2022; Accepted 27 May 2022; Published 16 June 2022

Academic Editor: Awais Ahmed

At present, with the acceleration of rural urbanization, people's market demand for new building materials is also increasing, and the research and development of new PVC/fine sand imitation stone composite materials are also in continuous progress and development. The purpose of this article is to analyze the feasibility of developing new PVC/fine sand imitation stone composite materials to promote rural urbanization and propose the application of more new PVC/fine sand imitation stone composite materials to our urbanization construction. In, we first conducted research on the new PVC/fine sand imitation stone composite material and rural urbanization, and then, we conducted research on the various properties of the new PVC/fine sand imitation stone composite material and the development of rural urbanization. The research results show that the new PVC/fine sand imitation stone composite material has at least 400% improvement in compressive performance compared with the traditional PVC material, and it is also better than the traditional PVC material in terms of the material expansion and contraction performance, which is more conducive to the application our rural urbanization is under construction.

1. Introduction

Urbanization is a natural historical process in which nonagricultural industries agglomerate in cities and towns and rural populations are concentrated in cities and towns along with the development of industrialization. It is an objective trend in the development of human society. Traditional urbanization has led to a series of problems in my country, such as uneven regional development, low resource carrying capacity, excessive reliance on land support, and environmental pollution. Therefore, a new type of urbanization has emerged. Polyvinyl chloride, as one of the world's earliest industrialized plastics, is one of the five general purpose resins. It has been widely used in national life and social economy because of its excellent performance and economic price. Polyvinyl chloride has excellent physical properties and has outstanding performance in corrosion resistance, chemical stability, and flame resistance. Compared with other materials, it has the advantage of low price. Therefore, PVC is widely used, and its use is in thermoplastic resin. It is second only to polyethylene, accounting for one-third of the total global synthetic resin consumption. In the social environment with the rapid development of science and technology and the gradual expansion of the application scope of polymer materials, the requirements for various materials in urbanization construction are getting higher and higher, and plastic products are required to meet the more and more precise division of labor, and the needs of the industry are increasing.

Architecture is a symbol of human civilization, and the regional and nationality of architecture are expressed by building materials. Although many people have conducted research on PVC composite materials, the research focuses on the application of PVC composite materials in traditional buildings, and there is no systematic detailed classification of contemporary applications of PVC composite materials. In the construction of a new type of urbanization, in today's urgent need for regional feelings, we take the application of PVC composite materials as the core part of in-depth research, apply its divergent thinking to all aspects of urbanization, and actively explore the use of bamboo and wood. The ideological expression, aesthetic expression, and technical expression of the local materials

represented by brick and stone in the new urbanization construction have summarized a set of guiding principles, which will be implemented in the future new urbanization construction and promote regional culture. With the rapid development of contemporary construction technology and new materials, the expression methods of PVC composite materials are no longer limited to traditional techniques. Under the guidance of new concepts and new processes, many innovative expression methods have been formed. The artistic appeal and spiritual symbolism of bamboo, wood, brick, and stone improve the aesthetic quality and cultural connotation of the building and give people the enjoyment of beauty [1]. The buildings in the new urbanization construction should strive to achieve equal emphasis on traditional PVC composite materials and modern technology and try to find a new way of innovation in the continuation. This is not only a respect for the local natural environment and national culture, but also a warning for modern people to lose themselves and blindly seek development.

With the continuous progress of society, the process of rural urbanization is also accelerating. Goodall SK based the research on the migration of nomads from rural to urban areas in the western Ladakh Himalayas and stated that the case study is consistent with the rapid urbanization currently underway in Leh related to [2]. Arouri M's survey on rural urbanization found that urbanization has stimulated the transition from agricultural activities to nonagricultural activities in rural areas. Rural households have experienced a decrease in agricultural income and an increase in wages and nonagricultural income. And urbanization helps rural families reduce the poverty rate of expenditure [3]. The development of the government governance system is also a major factor in promoting rural urbanization. In a study, Oke D analyzed some related factors of Lagos urbanization caused by rural to urban migration. The research results show that the education and modern transportation provided by the Lagos government are crucial to the country's urbanization drive [4]. In the process of rural urbanization, some problems inevitably arise. Guo Y's in-depth case study of the South China Sea in the Pearl River Delta revealed the unexpected seriousness between local villagers and migrant workers in villages undergoing effective urbanization, social inequality, and isolation [5]. Although some problems will inevitably arise in the process of rural urbanization, they cannot stop the development of urbanization. As a commonly used PVC composite material in rural construction, it is also undergoing continuous innovation and development. Dan-Asabe B pointed out that Dum Palm particle-reinforced polyvinyl chloride (PVC) composites were developed with relatively low-cost materials, providing overall light weight and good mechanical properties, which can be used as potential applications for pipeline materials [6]. Sacramento AS described a new method of producing antibody-like bionic materials in the study of composite materials. It includes the preparation of composite imprinting materials that have never appeared before, with highly conductive supporting nanostructures, and the assembly of highly conductive polymer layers at low temperatures [7]. In the research on the production of composite materials, people are also making continuous progress. In a research conducted by Lyubimova ON, a mathematical model and simulation method for calculating the temperature field and material property distribution in the production process of composite materials were provided to better study composite materials [8]. Although the continuous development of PVC composite materials has improved its own usability, PVC composite materials have also made some people not consider using them as building materials for houses and their decorations due to their low heat resistance [9].

The innovation of this article lies in the full research and analysis of new PVC composite materials and rural urbanization. The new PVC/fine sand imitation stone composite materials are used in rural urbanization construction, and new composite materials with more wear resistance, corrosion resistance, high flame resistance, and lower prices are introduced into rural urbanization construction. This is to help rural people build their homes by using more cost-effective materials.

2. Development of New PVC/Fine Sand Imitation Stone Composite Materials and Methods to Promote Rural Urbanization

2.1. PVC Material. Polyvinyl chloride, called PVC, is a white powder with an amorphous structure. In 1835, the Von Liebig Institute in Houston, Germany, synthesized vinyl chloride, and in 1872, Barman synthesized polyvinyl chloride [10, 11]. However, actual PVC products were not produced in the USA until the 1920s, and a large-scale production in Europe will begin in the next 20 years. Because of its abundant raw materials, the manufacturing process is very mature, the price is very low, and the uses are very wide. It is still second only to polyethylene resin in the world [12]. The two main general purpose resins account for 29% of the world's total synthetic resin production. There are many processing methods for PVC processing, such as molding, lamination, injection molding, extrusion molding, calendar ring, and brooch molding. PVC can manufacture software products and hardware products. Among them, software products mainly include artificial leather, films, steel wire sheaths, and soft boards, and hardware products mainly include boards, doors, windows, pipes, valves and other configuration materials [13]. Chlorinated polyethylene has excellent flame retardancy and high chemical resistance [14].

Polyvinyl chloride is a noncrystalline polymer, and its main feature is that it is amorphous, nonbranched, and regularly arranged with lock-like links. The polymerization degree n of polyvinyl chloride is generally 500~2000. This material is a material with high mechanical strength, and its chemical properties are very stable [15]. Due to the large amount of chlorine molecules in the molecular structure, it has high polarity and excellent flame retardancy. Plastic products made of polyvinyl chloride have excellent advantages such as abrasion resistance, acid resistance, alkali resistance, and insulation [16]. However, the optical

and thermal stability of the device is relatively low, and if no thermal stabilizer is added, it starts to decompose at 100 degrees Celsius. Experiments show that the higher the temperature, the faster the decomposition [17]. At present, the PVC industry is developing rapidly all over the world and has broad prospects. All countries are optimistic about the possibilities of PVC and the benefits of the ecological environment. With its outstanding and unique performance, PVC has proved its role to the world. Yes, social development needs it, and environmental protection needs it. This is an inevitable trend of the progress of our human social civilization [18].

2.1.1. Preparation of PVC Composite Materials. According to the formula, the uniformly mixed materials are supplied to the extruder barrel through the hopper. Under the action of the rotating movement of the screw, the material mixture moves along the rotation until it is pressed in front of the barrel, and then is cooled and formed, and the pushed product is completed. Figure 1 shows part of the production machine required for the preparation of PVC composite materials [19]. These machines have their own preparation process, in different forms.

Figure 2 shows the production flow chart of the new PVC/fine sand imitation stone composite material.

A composite material is a combination of one material as the matrix and another as the reinforcement [20]. Various materials complement each other in terms of performance, resulting in a synergistic effect, so that the comprehensive performance of the composite material is better than that of the original material to meet various requirements. With PVC as the matrix, it is divided according to different types of reinforcements. There are currently 4 categories. PVC composite materials: one is fiber, the other is powder, and the third is granular, such as PVDC and polyurethane.

After the preparation of the PVC composite material, the thermal conductivity and flame retardant performance should be tested separately. In the production process, since PVC is a heat-sensitive material, even adding a heat stabilizer can only increase the decomposition temperature and prolong the stabilization time without decomposition [21]. This requires that the molding processing temperature of PVC should be strictly controlled. In particular, rigid PVC, because its processing temperature is very close to the decomposition temperature, often decomposes due to improper temperature control. The quality of extrusion granulation is closely related to the characteristics of the extruder, the structure of the head, the temperature, the feeding speed, the rotation speed of the main engine, the traction speed, and other factors. In the thermal conductivity test, the composite material sample is made into a circular sample with a diameter of 6 mm, and the upper temperature of the instrument is set to 36°C, and the lower temperature is set to 15°C, when the indicator does not change more than 0.1 within one minute. Put the sample on the thermal conductivity tester at °C, start the test after the thermal conductivity is stable, test once a minute, start counting, and measure three times within the range of the value difference not exceeding 5% [22]. The calculation formula of thermal conductivity:

$$\frac{\Delta W}{\Delta T} = \lambda * Q \frac{\theta_1 - \theta_2}{H}. \tag{1}$$

When testing the flame retardancy of PVC composite materials, the sample size is as follows: length × width × height = (100 mm) × (6.5 ± 0.5 mm) × (3 ± 0.5 mm). During the test, first consult the literature to estimate the range of the oxygen index of the sample, adjust the oxygen and nitrogen proportionally to this value, clamp the sample vertically on the iron clamp, and then use an igniter to ignite [23]. Adjust the ratio of oxygen and nitrogen, and observe the burning distance of the sample after 3 minutes until the burning of the sample starts timing. If it exceeds 60 mm, it means that the oxygen concentration is high and adjusts it downward; if it is less than 60 mm, it means that the oxygen concentration is low and adjusts it upward. When it reaches 60 mm in 3 minutes, the oxygen content is the oxygen index of the composite material. The calculation formula of oxygen index is as follows:

$$\mathrm{OT} = \frac{\mathrm{WO}_2}{\mathrm{WO}_2 + \mathrm{WM}_2} * 100\%, \tag{2}$$

where OT represents the oxygen index, WO_2 represents the oxygen flow rate, and WM_2 represents the nitrogen flow rate.

2.1.2. Composite Material Processing Performance Test. The polymer melt can exhibit viscous flow and elastic deformation under the influence of external force, so the processing and molding of PVC are manifested in viscous flow [24]. The most basic manifestation of its processing performance is its rheological properties, and rheological properties refer to the viscous flow of materials. For a long time, scholars have established the relationship between the speed and torque in the torque rheometer for the first time, to the research on the theoretical model of the processing conditions, rheological parameters and geometric dimensions of the torque rheometer, and then to Bousmina. Based on the power law fluid equation, a series of theoretical derivations are carried out, and the following relational expressions are obtained. When the fluid flows in the pipeline, the distance it flows in a certain period of time is the flow velocity. The flow velocity generally refers to the average flow velocity of the fluid, and the unit is m/s.

$$\Gamma = 2^{2N+1}\pi^{N+1}\mathrm{WLR}^2{}_B M^N \frac{1+q^{N+1}}{\left[N\left(\beta^{2/N}-1\right)\right]^N}, \tag{3}$$

$$R_n = 2^{n+1}\pi^{n+1}\mathrm{LR}_B^2 \frac{1+q^{n+1}}{\left[n\left(\beta^{2/n}-1\right)\right]^n}, \tag{4}$$

$$\beta = \frac{R_B}{R_I}, \tag{5}$$

Figure 1: Part of the machine diagram for preparing PVC composite materials.

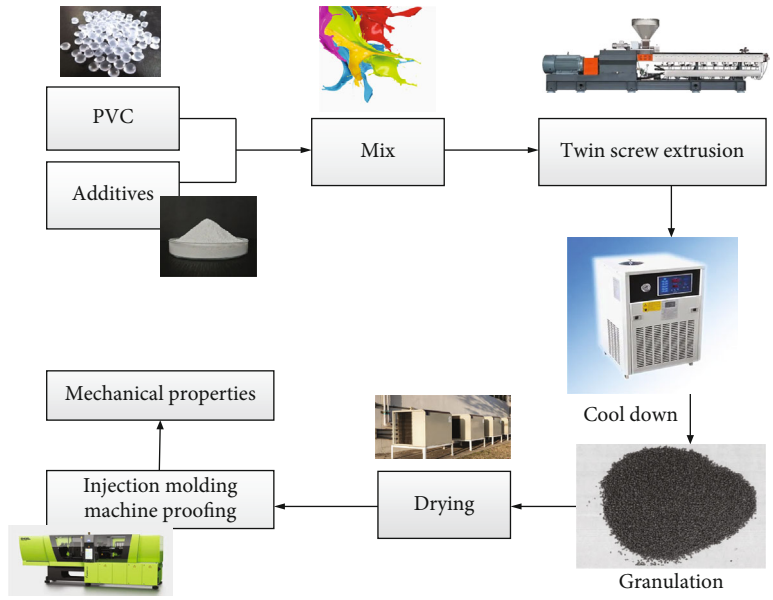

Figure 2: The production flowchart of the new PVC/fine sand imitation stone composite material.

where R_B is the equivalent radius; R_I is the radius of the mixer; L is the length of the rotor; q is the speed ratio of the two rotors; Γ is the balance torque, $N \cdot m$; W is the consistency coefficient; n is the power law index; and WL is the indicator. The above formula can be transformed to obtain the rotor equivalent radius R_I formula, as shown in

$$R_I = \frac{R_B}{\left[1 + (4\pi N/n)(2\pi \mathrm{WLR}_B^c(1 + q^{N+1}/\Gamma))^{1/n}\right]^{n/2}}. \quad (6)$$

Bousmina also gave the calculation formula of the shear rate and shear viscosity of the polymer melt in the torque rheometer, as shown in

$$\chi = \chi_{1/2} = \frac{2^{2(1+(1/N))}\pi n}{N} \frac{\beta^{2/N}}{(1+\beta)^{2/N}\left(\beta^{2/N} - 1\right)}, \quad (7)$$

$$\eta(\chi) = \frac{\Gamma}{\pi L(R_B + R_I)(1 + q^{N+1})\chi}. \quad (8)$$

However, when Bousmina calculates the melt viscosity and equivalent radius, it is calculated according to the set temperature of torque rheology. It does not take into account the actual temperature of the material in the cavity, so some scholars have carried out temperature correction.

The relationship between viscosity and temperature is as follows:

$$\eta = A \exp(\Delta Q/RE). \quad (9)$$

From the above formula:

$$\frac{\eta(E)}{\eta(E)'} = \frac{\Gamma(E)}{\Gamma(E)'} = \exp\left[\frac{\Delta Q}{R}\left(\frac{1}{E} - \frac{1}{E'}\right)\right]. \quad (10)$$

2.2. Rural Urbanization. "Urbanization" has a very rich connotation. It was in the twentieth century that urbanization gradually became popular and accepted by the masses. With the development of society and economy, the concept and connotation of urbanization are constantly enriched and improved [25]. Scholars in various fields have given meaning to urbanization from various angles. Sociologists believe that urbanization is a process by which rural residents enjoy the material and spiritual enrichment brought about by urban development and urban production and lifestyle changes. Many scholars have studied this transformation through the illiteracy rate, mass communication penetration rate, and language uniformity rate. Demographers believe that urbanization is a process in which local populations continue to gather in cities and cities. This process will inevitably lead to an increase in the number of cities and cities. The essence of urbanization is the

urbanization of the population. Many scholars' research on the level of urbanization is also based on the ratio of urban permanent residents to the total population [26].

2.2.1. Development History of Urbanization. The urbanization process since the founding of New China is roughly divided into three stages. The first stage: 1949~1957. Soon after the founding of the People's Republic of China, it entered a period of large-scale industrialization and urban construction under the "First Five-Year Plan." The second stage: from 1958 to 1978. The urban population accounts for 30%~70% of the total population. Urbanization has entered a period of rapid development, and the urban population can exceed 50% in a relatively short period of time and then rise to about 70%. The third stage: Since 1978, since the reform and opening up, China has entered a stage of steadily advancing urbanization. The implementation of a series of reform and opening policies has greatly promoted the development of urbanization. In the 42 years from 1978 to 2020, the level of urbanization in China has increased from 17.9% to 63.89%. Figure 3 shows the development map of China's urbanization process.

2.2.2. Measurement of Urbanization Level. The level of urbanization is an important indicator of the social and economic development of countries and regions. It has always been the focus of scholars to determine the level of urbanization in line with reality through scientific and objective methods [27]. There are many methods to measure the level of urbanization, which can generally be divided into four categories: entropy method, population index method, other main index method, and compound index method.

The first introduction is the entropy method. "Entropy" is the measure of uncertainty. Experiments show that the more elements, the more comprehensive the index, the smaller the uncertainty, and the smaller the entropy. Experiments show that the fewer the elements, the higher the unilateralist of the index, and the greater the uncertainty [28]. Therefore, the degree of dispersion of the index can be judged from the result of the entropy value. Experiments show that the smaller the entropy value, the greater the weight and the greater the degree of dispersion. Experiments show the greater impact of indicators on the results and vice versa. The calculation steps of the entropy method are as follows:

(1) Matrix construction and standardization: Assuming a comprehensive evaluation of the y indicators of w objects, a matrix of 18 $w \times y$ can be established, where Amn represents the value of the nth indicator in the m area, $m = 1, 2, \cdots, W$, $n = 1, 2, \cdots, y$; w is the number of regions, and y is the number of indicators

(2) Data standardization: The unit, positive and negative directions, and the size of various indicators are different, and the original data must be standardized. The formula for calculating the positive index is as follows:

$$A'_{mn} = (A_{mn} - \min\{A_n\})/(\max\{A_n\} - \min\{A_n\}). \quad (11)$$

The calculation formula of the negative index is

$$A'_{mn} = (\max\{A_n\} - A_{mn})/(\max\{A_n\} - \min\{A_n\}). \quad (12)$$

(3) Calculate the proportion of the j-th index value in the i-th year:

$$T_{mn} = \frac{A'_{mn}}{\sum_{m=1}^{w} A'_{mn}}. \quad (13)$$

(4) Calculation of index entropy:

$$O_n = -K \sum_{m=1}^{w} (T_{mn} * \ln T_{mn}). \quad (14)$$

(5) Calculation of entropy redundancy:

$$D_m = 1 - O_n. \quad (15)$$

(6) The weight of the indicator:

$$q_m = \frac{D_m}{\sum_{n=1}^{w} D_m}. \quad (16)$$

(7) Evaluation scores for individual indicators:

$$E_{mn} = q_m * A'_{mn}. \quad (17)$$

(8) Comprehensive level score of the i-th year:

$$E_m = \sum_{n=1}^{y} E_{mn}. \quad (18)$$

The second introduction is the population index method, which indicates that the level of urbanization is

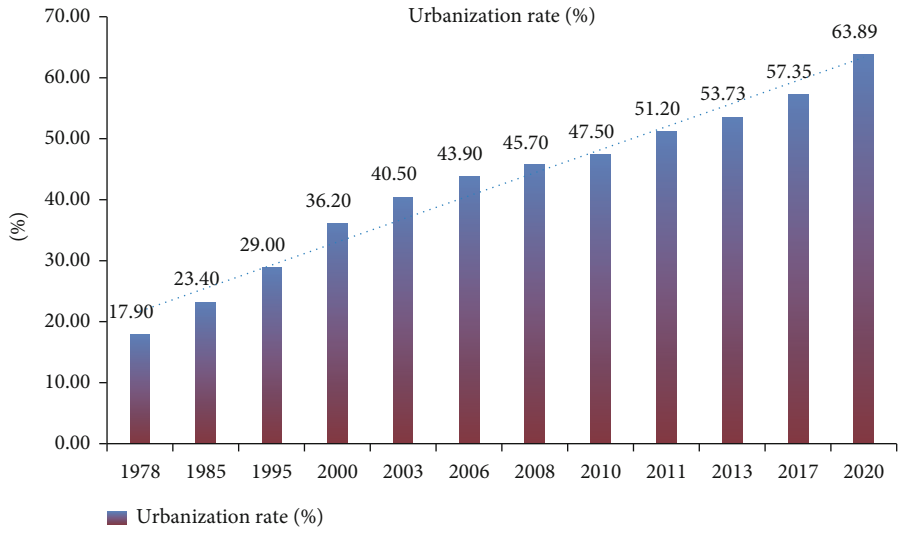

Figure 3: Development of China's urbanization process.

the ratio of the urban population (or urban nonagricultural population) to the total population. The formula is as follows:

$$\mathrm{CU} = \frac{U}{C} * 100\%, \tag{19}$$

where CU represents the level of urbanization, C represents the total population, and U represents the urban population. Towns and villages are the two basic forms of human settlements, and their essence is the agglomeration of population in space. From the perspective of population aggregation, the difference between towns and villages lies in the fact that towns have large populations, large scales, and high densities, and the opposite is true in rural areas [29]. Population urbanization is the process of population transfer and agglomeration from rural to urban areas. It is the result of the combined effect of the "pull force" of cities and towns and the "push force" of rural areas. It is the essence of urbanization.

Finally, the compound index method is introduced, which refers to selecting several or more indicators that reflect the various characteristics of urbanization, and by calculating the weights of each indicator and summing them, the total score representing the comprehensive level of urbanization in a country or region is obtained. The mathematical expression of this method is as follows:

$$P = \sum F_i G_i, \tag{20}$$

where P refers to the comprehensive level of urbanization, F_i refers to the value of various indicators in urbanization, and G_i refers to the weight corresponding to each indicator. The compound index method is to overcome the shortcomings and limitations of the single index method, trying to measure the comprehensive level of urbanization from multiple perspectives of the connotation of urbanization [30]. Although the compound index method can fully reflect the connotation of urbanization, its biggest disadvantage lies in its strong pertinence and weak versatility.

2.2.3. The Development and Content of New Rural Urbanization. With the continuous development of society, the process of urbanization in rural areas has been accelerating. With the continuous development of urbanization, rural infrastructure has been improved, basic housing conditions have been improved, and the presence of large industrial and commercial enterprises has provided a large number of employment opportunities for people in rural areas. However, with the development of urbanization, farmland resources in rural areas are continuously lost, environmental pollution has increased, and large numbers of rural people have migrated to cities. Figure 4 shows the problems caused by the process of rural urbanization in some areas.

In the process of rural urbanization development, five requirements must be followed, namely, integrating urban civilization on the basis of protecting rural culture, integrating urban-rural integration with local characteristics, new-type urbanization must focus on environmental protection, and new-type urbanization. When the "elements" are pushed forward neatly, the reform of the land management system must be followed up. Figure 5 is a schematic diagram of the five requirements for the development of rural urbanization.

2.2.4. Characteristics of Urbanization. First, people are the core of development. The core of the scientific concept of development is people-oriented. The new type of towns urges cities to provide complete basic public services; solve the problems of difficult medical treatment, expensive medical treatment, and difficulty in schooling; and realize the equalization of rural residents in pension insurance, medical treatment, salary level, children's education, housing, and comprehensive coverage. The permanent population of the city enables the vast number of migrant workers entering the city to also enjoy the public services that urban

Figure 4: Part of the problems caused by the process of rural urbanization.

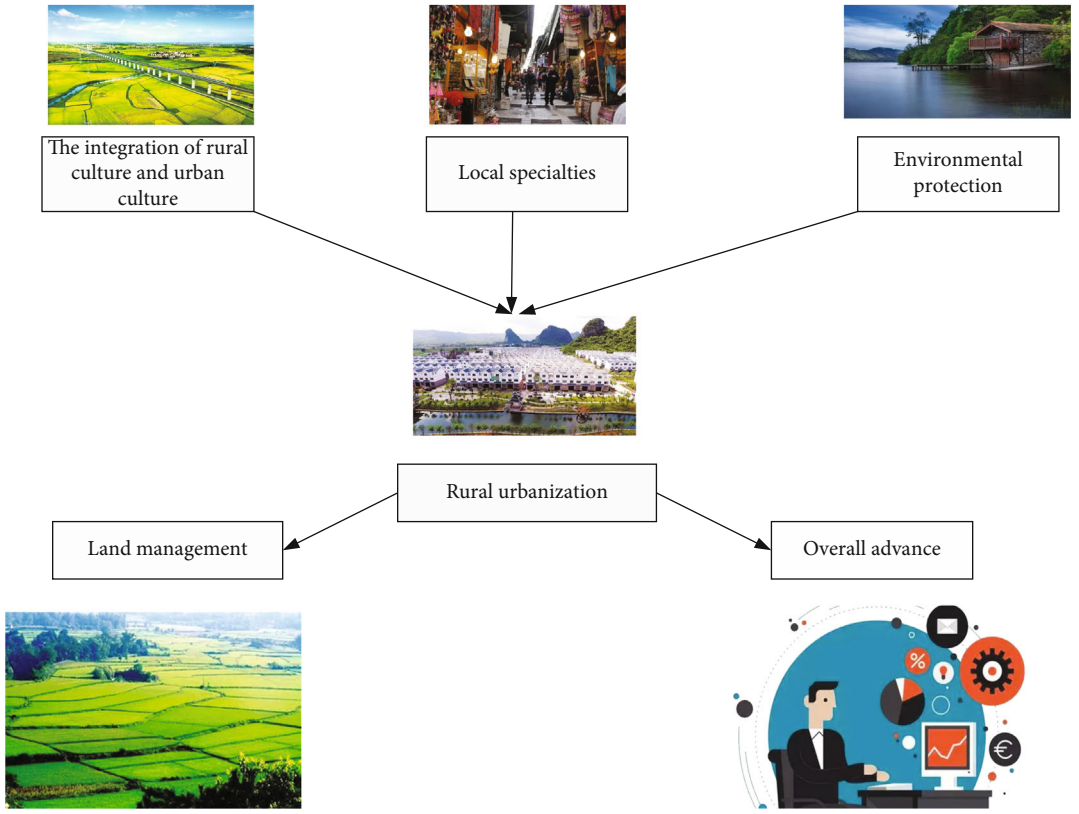

Figure 5: Five requirements for the development of rural urbanization.

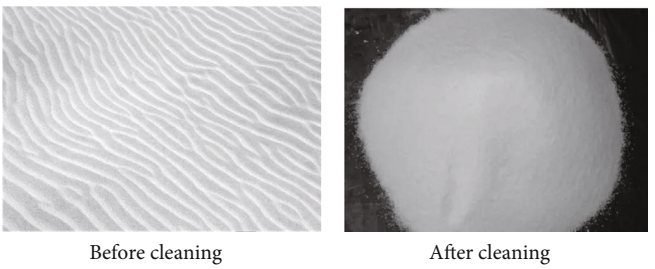

Figure 6: Comparison of fine sand before and after treatment.

residents should have and then live and work in peace and contentment.

The second point is the intensification of development models. Intensive development refers to improving labor productivity by improving technology and improving management methods, continuously reducing energy consumption and production costs, and improving the quality and efficiency of production factors to achieve economic growth.

The third point is to coordinate urban and rural development. Traditional urbanization refers to the transfer of rural

Table 1: World demand for several commonly used plastics.

Plastic type	1990/ 10,000 tons	2010/ 10,000 tons	2016/ 10,000 tons	26-year growth rate
HDPE	1200	3590	4690	4.6
PVC	1870	3610	5470	6.0
EPS	280	620	750	5.2
PA	200	360	400	5.3
PET	270	1650	2130	5.1
LDPE	1980	4020	4970	4.1
PP	1390	5190	6890	5.2
ABS, ASA	380	830	960	4.1
PC	150	440	510	3.8
PU	560	1290	1560	5.4
Total	9180	22770	30210	

population to cities, and the indicator to measure the level of urbanization is also the proportion of urban permanent residents to the total population of the city. The urbanization model that sends samples can be said to be a "population transfer" urbanization path. However, urbanization is also a comprehensive indicator that reflects the level of economic development of a region. The new urbanization believes that as the speed of urbanization continues to accelerate, the urban industrial structure is continuously adjusted and further optimized, and the economic links between cities and regions become closer. The flow of resources between urban and rural areas is more convenient and effective, the income gap between urban residents and rural residents will continue to shrink, basic social welfare will be equalized, development barriers between urban and rural areas will be eliminated, and the integrated development of urban and rural areas will be truly realized. The coordinated development of urban and rural areas is to maintain equal emphasis on urban and rural areas and narrow the gap. The two forms of social and economic spatial organization of urban and rural areas cannot be homogenized. The construction of new rural areas must maintain the local characteristics and original features of rural areas. Persisting in the coordinated development of urban and rural areas and urban radiation and driving rural development and rural promotion and support for the rise of cities are an effective way to enhance the overall economic and social development of a country and region, and it is also the only way to long-term development.

The fourth point is the sustainability of development. The new urbanization adheres to the premise of "ecological protection" and achieves simultaneous urbanization in the four aspects of population, society, economy, and land. With the advancement of new urbanization, the protection and construction of urban ecology should be equally emphasized, industrial upgrading should be accelerated, the development of modern service industries and modern agriculture should be accelerated, the gap between urban and rural areas should be continuously narrowed, and the fruits of social development can be shared by all, and the rational development and utilization of energy should be achieved by controlling the rate of economic growth. Coordinating the relationship between man and nature with resources effectively curbs the "urban diseases" caused by traditional urbanization, such as traffic congestion, environmental degradation, and polarization between the rich and the poor, so as to achieve an orderly, healthy, and sustainable development of towns.

2.3. New PVC/Fine Sand Imitation Stone Composite Material. The new PVC/fine sand imitation stone composite material is a new composite material made by combining PVC material and fine sand. This material is superior to traditional composite materials in terms of heat resistance, scalability, and impact resistance. This article mainly introduces the production of the composite material.

2.3.1. Preliminary Treatment of Fine Sand. The fine sand we see is basically free of impurities, and the sand grains are relatively regular, but it cannot be denied that some sand grains are attached to the surface of yellow-brown. In the pretreatment of fine sand, it is first necessary to rinse with water to remove the mud and attachments on the surface of the fine sand and to increase the twisting force between the surface of the fine sand and the PVC molecular chain before use. In order to make the surface of the fine sand look rough and concave, alkali immersion cleaning is performed. After these cleaning steps are completed, polar chemical bonds will be formed on the surface of the fine sand. Figure 6 is a comparison diagram of fine sand before and after cleaning:

2.3.2. Pretreatment of PVC/Fine Sand Imitation Stone Composite Material. The first step is to modify the surface of the fine sand and use a coupling to correct the surface of the pretreated fine sand. Increase the friction force indicated by the fine sand, make the reinforced material (fine sand) compatible with the matrix (PVC), and improve the performance effect of promoting various characteristics of the composite material after forming. Secondly, the required components of the composite material are proportioned, and the dyeing treatment is carried out. According to the performance requirements of composite materials, the matrix can be divided into one or more types using polymer compounds. As a reinforcing material, the fine sand and the addition amount can also be adjusted in a wider range according to different usage requirements. The general purpose is to add to the quality of PVC and fine sand at a ratio of 1 : 3 and use other additives such as composite heat stabilizers. A variety of color series using organic pigments is to dye the modified sand and the dyeing of the mixture of PVC and sand (or pure PVC) to have a better effect and also make the color of the composite material uniform and bright. The third step is to use an internal mixer to mix the modified and dyed sand and PVC and add plasticizers for mixing and preplasticization and thermal stability to compress them. It can also be molded by extrusion molding, injection molding, and other methods. Finally, there is the surface treatment part. The surface treatment uses

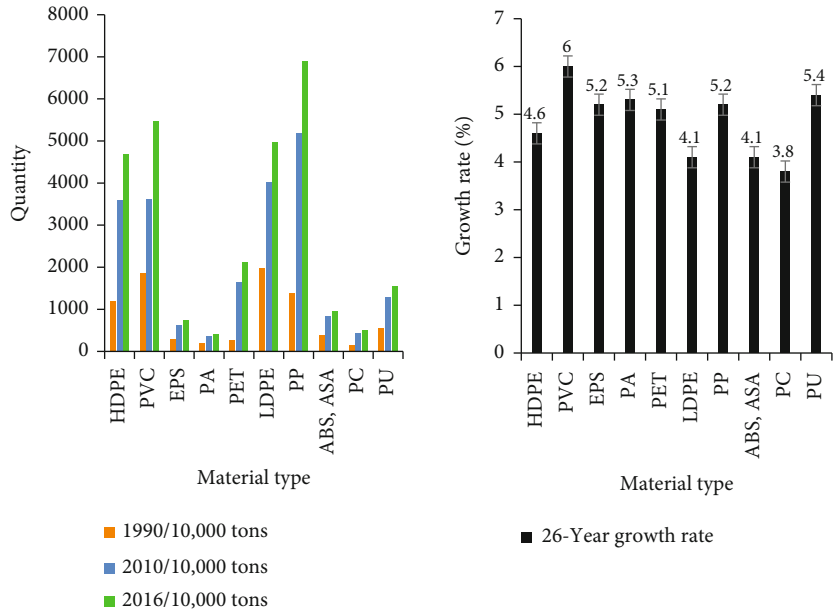

Figure 7: Changes in world demand for several common plastics.

PVC/fine sand composite material to evenly disperse the fine sand particles on the substrate. The color of the fine sand particles and the accumulation state of the particles will be changed by the corresponding process. The surface of the composite material can show the texture of various sandstones. Its appearance can be made into a smooth surface with limited molding once, or it can be formed only once.

3. Experimental Design and Result Analysis of New PVC/Fine Sand Imitation Stone Composite Materials and Promotion of Rural Urbanization Construction

3.1. Investigation and Result Analysis of Changes in the Consumption Demand of PVC Materials. The demand for plastics is increasing worldwide. According to the relevant data of the world plastics industry, from 1990 to 2016, all kinds of plastics in the world have been growing steadily. Table 1 shows the global demand for some commonly used plastics.

According to the latest data report from an agency in the USA, the global demand for plastic pipes has steadily increased at an annual rate of 8.5% from 2013 to 2017. Among them, chlorinated polyethylene is a resin suitable for manufacturing pipes. PVC is an organic polymer compound polymerized by vinyl chloride under the condition of a starting agent. It is one of the world's five main general purpose plastics and is supported in all fields. It is now a plastic variety second only to polyvinyl chloride and polypropylene.

According to Table 1, we can get the world demand change diagram of several commonly used plastics around the world, as shown in Figure 7.

Table 2: Vicat softening temperature table of common plastics.

	Minimum softening temperature	Maximum softening temperature
Polyvinyl acetate	35	85
Polyoxymeth	165	185
Polystyrene	70	115
Polypropylene	160	170
Polyvinyl chloride	60	85
Nylon12	170	180
Compound PVC	90	110

From Figure 7, we can see that the main market shares are polyethylene plastic (PE), polypropylene plastic (PP), polyvinyl chloride plastic (PVC), and polystyrene plastic (PS), and the future of plastics in the market Demand will also continue to expand. Among them, PVC has the fastest growth rate, reaching a growth rate of 7%.

3.2. Test and Analysis of the Heat Resistance Performance of the New PVC/Fine Sand Imitation Stone Composite Material. Vicat softening temperature is an important index for evaluating the heat resistance of materials and reflecting the physical and mechanical properties of products under heating conditions. The higher the Vicat softening temperature of the material, the higher the dimensional stability of the material when heated, the lower the possibility of thermal deformation, and the higher the heat resistance of the material. Table 2 is the Vicat softening temperature table of some common plastics.

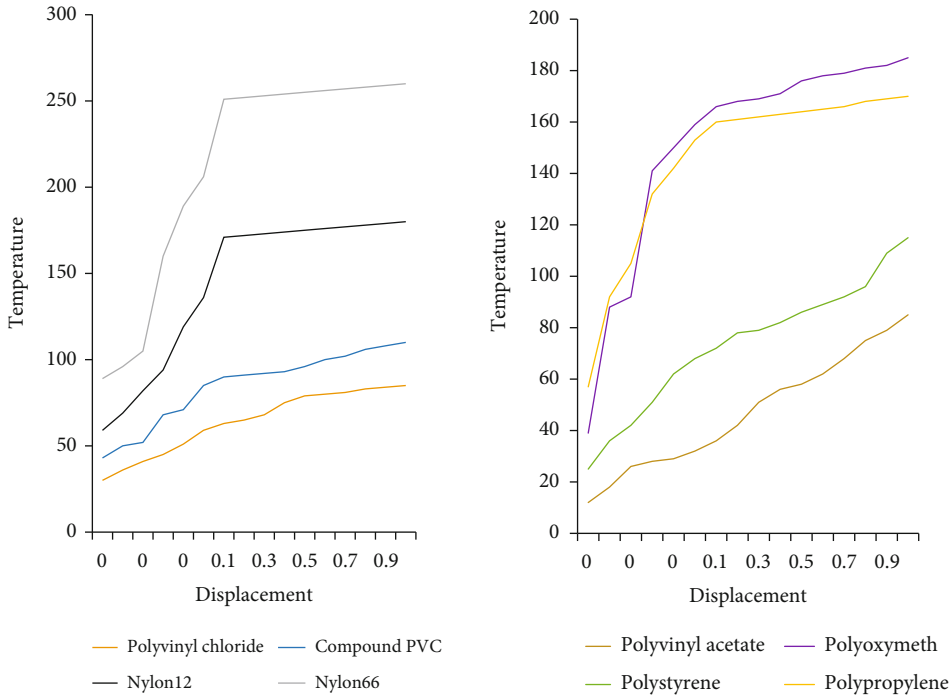

Figure 8: Comparison of Vicat softening temperature of some materials.

According to Table 2 and related literature data, we can get the Vicat softening temperature comparison chart of some plastics, as shown in Figure 8:

According to Figure 8, we can conclude that the Vicat softening temperature of some materials such as polyoxymethylene, polypropylene, and nylon 12 exceeds 160°C, while the Vicat softening temperature of ordinary PVC materials is 63°C. The average Vicat softening point of the sand imitation stone composite material is 103°C. Although materials such as polyoxymethylene and polypropylene have higher heat resistance than PVC materials, these materials are not suitable for ordinary construction. Although the heat resistance of traditional PVC materials is not high, it also meets the requirements of modern and ordinary construction. With the development of new PVC composite materials, its heat resistance is higher than that of ordinary PVC materials, so it has a wider range of applications and is more popular than traditional PVC materials. Due to its high chemical stability, it can be used to make anticorrosion pipelines, pipe fittings, oil pipelines, centrifugal pumps, and blowers. The rigid board of PVC is widely used in the chemical industry to make the lining of various storage tanks, corrugated boards of buildings, door and window structures, wall decorations, and other building materials. Due to its excellent electrical insulation properties, it can be used in the manufacture of plugs, sockets, switches, and cables in the electrical and electronic industries.

3.3. Comprehensive Performance Test and Result Analysis of the New PVC/Fine Sand Imitation Stone Composite Material. In order to better test the various properties of the new PVC/fine sand imitation stone composite material, we conducted related experiments on the composite material's compression resistance, abrasion resistance, and scalability. Table 3 and Table 4 are the compressive strength performance test table and the expansion performance test table of the new PVC/fine sand imitation stone composite material, respectively.

Table 3: Compressive strength performance test table.

	Test result 1	Test result 2	Average value
1	9.2	9.6	9.4
2	8.6	9.0	8.8
3	10.8	10.4	10.6
4	16.4	15.2	15.8
5	18.6	19.6	19.1
6	12.9	13.1	13.0

Table 4: Scale performance test table.

	Test result 1	Test result 2	Average value
1	98	112	105
2	152	156	154
3	182	184	183
4	194	206	200

According to the experimental results in Table 3 and Table 4, it can be concluded that the average compressive strength of the new PVC composite material is higher than 9KJ/m^2, and the average value of its expansion performance is greater than 100 MPa. The reason for the large difference

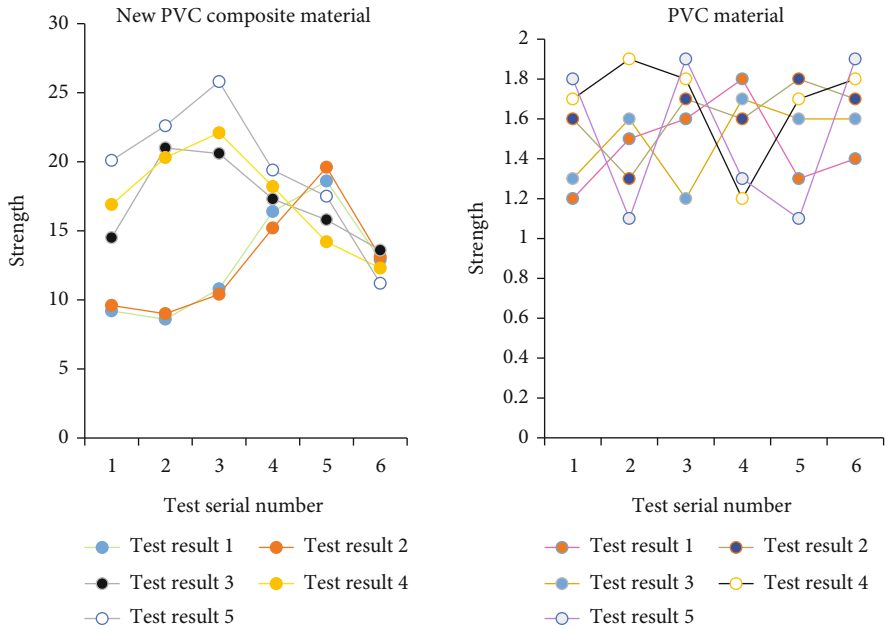

Figure 9: Comparison of the compressive strength of the new and old PVC materials.

between the experimental data of the same material is that the given pressure is quite different. According to some other experimental data, we get a comparison chart of the compressive strength of the new PVC composite material and the compressive strength of ordinary PVC, as shown in Figure 9:

According to Figure 9, we can find that the compressive strength of the new PVC composite material is more than 400% higher than that of the ordinary PVC material. Therefore, the application range of the new PVC fine sand imitation stone composite material in the construction of rural urbanization will be much larger than that of ordinary PVC materials. The two properties of pressure resistance and elasticity can be regarded as outstanding features of the new PVC/fine sand imitation stone composites.

3.4. Rural Urbanization Survey and Result Analysis. This survey is aimed at a certain province in central China. We have investigated the changes in population and urban size in the development of rural urbanization in this province. We analyze from three perspectives: population, number of towns, and number of companies. The specific survey results are shown in Table 5:

According to Table 5, we can see that with the development of rural urbanization in this province, the number of rural urban population has increased, and the number of industrial enterprises in rural urban areas is also increasing. According to some data we have, we have obtained the changes in China's urban population over a period of time, as shown in Figure 10:

According to Figure 10, we can see that between 2008 and 2015, the proportion of urban population has increased by 10%, and the number of people absorbed by the eastern region far exceeds that of other regions, accounting for more than 70% of the total population. With the acceleration of the urbanization process, the vigorous construction of various infrastructures, the development of houses, and the development of industry, people's demand for new PVC materials will gradually increase.

Table 5: Changes in various factors in rural urbanization.

	Population	Number of towns	Number of companies
2014	2501000	3	15
2015	2543000	4	21
2016	3620100	5	29
2017	3692001	7	35
2018	3764100	9	41
2019	3859000	12	48
2020	3964001	15	55
2021	4042100	17	64

4. Discussion

This article is devoted to the research of the new PVC/fine sand imitation stone composite material, and the development of the new PVC/fine sand imitation stone composite material is applied to the feasibility study of our rural urbanization. We not only discussed the new PVC/fine sand imitation stone composite material, but also studied the preparation material and preparation process of the new PVC/fine sand imitation stone composite material. At the same time, we also conducted research and analysis on our urbanization development process and other aspects. In this article, we have analyzed the demand for PVC materials. Through the study of the new and old PVC materials, the results show that the new PVC/fine sand imitation stone

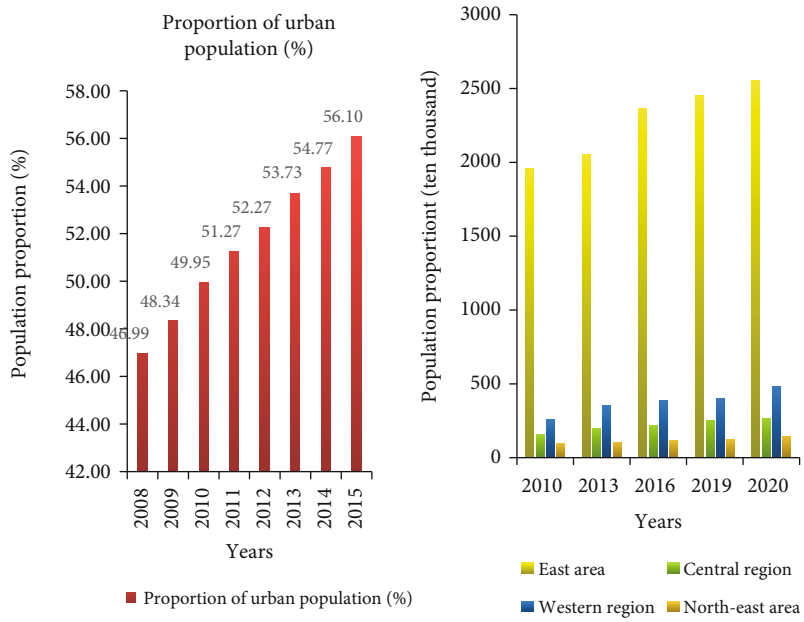

Figure 10: Urban population change map.

composite material is more in line with the product's compressive strength and expansion performance.

Through the analysis of the case in this article, we can conclude that the development and application of the new PVC/fine sand imitation stone composite material are more conducive to rural urbanization. In the process of urban construction, people can apply the new PVC/fine sand imitation stone composite material to our house construction, house decoration, parks, bridges, and guardrails. By using the new PVC/fine sand imitation stone composite material, not only can it improve its compression resistance, abrasion resistance, and heat resistance, but the appearance of the new PVC/fine sand imitation stone composite material is more tactile and cost-effective. It is cheaper than other materials.

This article starts with the global demand for PVC materials. Through the changes in demand for PVC, the performance test, and analysis of the new PVC/fine sand imitation stone composite material, the advantages of the new PVC/fine sand imitation stone composite material in the rural urbanization construction are studied. Research and analysis show that the new PVC/fine sand imitation stone composite material has more advantages in terms of comprehensive performance, use, cost, and appearance and has more application markets in rural urbanization.

5. Conclusions

Through the research and analysis of the results of the experiments and cases in this article, we have come to an important conclusion: With the continuous development of society, the process of rural urbanization is also developing rapidly, and China's urbanization rate increased during 2008-2015 alone, by 10%. The development of urbanization is indispensable to the construction of various infrastructures in cities and towns, and the new PVC/fine sand imitation stone composite materials have also played an indispensable role in these constructions. Our research shows that the compressive performance of the new PVC/fine sand imitation stone composite material is 400% higher than that of the traditional PVC material, and there has been a lot of improvement in the elasticity of the material. In the construction of urbanization, more use of new PVC/fine sand imitation stone composite materials can not only improve the reliability of the building, but also reduce the construction cost of the building. While the above conclusions are obtained in this paper, due to the limitation of time, energy, and processing conditions, there are still some imperfections in the experiment, which need to be further improved.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

References

[1] P. Wang, T. Yao, Z. Li et al., "A superhydrophobic/electrothermal synergistically anti-icing strategy based on graphene composite," *Composites Science and Technology*, vol. 198, article 108307, 2020.

[2] S. K. Goodall, "Rural-to-urban migration and urbanization in Leh, Ladakh," *Ladakh. Mountain Research & Development*, vol. 24, no. 3, pp. 220–227, 2004.

[3] M. Arouri, A. B. Youssef, and C. Nguyen, "Does urbanization reduce rural poverty? Evidence from Vietnam," *Economic Modelling*, vol. 60, pp. 253–270, 2017.

[4] D. Oke, K. G. Bokana, and O. A. Shobande, "Some correlates of rural-urban led urbanization in Lagos, Nigeria," *Review of Urban & Regional Development Studies*, vol. 29, no. 3, pp. 185–195, 2017.

[5] Y. Guo, J. Zhu, and X. Liu, "Implication of rural urbanization with place-based entitlement for social inequality in China," *Cities*, vol. 82, pp. 77–85, 2018.

[6] B. Dan-Asabe, S. A. Yaro, and D. S. Yawas, "Micro-structural and mechanical characterization of doum-palm leaves particulate reinforced PVC composite as piping materials," *AEJ-Alexandria Engineering Journal*, vol. 57, no. 4, pp. 2929–2937, 2018.

[7] A. S. Sacramento, F. Moreira, J. L. Guerreiro, A. P. Tavares, and M. G. F. Sales, "Novel biomimetic composite material for potentiometric screening of acetylcholine, a neurotransmitter in Alzheimer's disease," *Materials Science and Engineering*, vol. 79, no. oct., pp. 541–549, 2017.

[8] O. N. Lyubimova and M. A. Barbotko, "Modeling of heat transfer due to induction heating of laminated glass-metal materials," *Thermophysics and Aeromechanics*, vol. 28, no. 1, pp. 87–102, 2021.

[9] N.'. A. Yusof, S. S. M. Ishak, and R. Doheim, "An exploratory study of building information modelling maturity in the construction industry," *International Journal of BIM and Engineering Science*, vol. 1, no. 1, pp. 6–19, 2018.

[10] S. Han, ""Hollow Village" evolution and policy control from the perspective of rural urbanization: a case study of Jiangsu Province," *Asian Agricultural Research*, vol. 3, no. 264, pp. 26–30, 2016.

[11] H. E. Unal, U. Birben, and F. Bolat, "Rural population mobility, deforestation, and urbanization: case of Turkey," *Environmental Monitoring and Assessment*, vol. 191, no. 1, pp. 1–12, 2019.

[12] L. Christiaensen and M. Gindelsky, "Demography, urbanization and development: rural push, urban pull and urban push?," *Journal of Urban Economics*, vol. 98, no. Mar., pp. 6–16, 2017.

[13] T. Isobe, T. Seike, Y. Kim, A. Ito, and Y. Harada, "Analyzing the material flow of PVC scrap in East Asia," *Journal of Life Cycle Assessment Japan*, vol. 12, no. 3, pp. 196–207, 2016.

[14] A. Banawi, O. Aljobaly, and C. Ahiable, "A comparative review of building information modeling frameworks," *International Journal of BIM and Engineering Science*, vol. 2, no. 2, pp. 23–48, 2019.

[15] A. Uherkova, Z. Adamec, J. Kadavý, M. Kneifl, and R. Knott, "Coppice-with-standards between urbanization and rural development of forestry," *Pub Recreat Lands C*, vol. 2018, pp. 85–89, 2018.

[16] X. Cui, J. Xiao, Y. Wu et al., "A graphene composite material with single cobalt active sites: a highly efficient counter electrode for dye-sensitized solar cells," *Angewandte Chemie*, vol. 128, no. 23, pp. 6820–6824, 2016.

[17] X. Cui, J. Xiao, Y. Wu et al., "A graphene composite material with single cobalt active sites: a highly efficient counter electrode for dye sensitized solar cells," *Angewandte Chemie International Edition*, vol. 55, no. 23, pp. 6708–6712, 2016.

[18] H. Chen, Y. Xu, J. Yang, and Y. Liu, "A novel discrete computational tool for microstructure-sensitive mechanical analysis of composite materials," *Materials Science & Engineering A*, vol. 659, pp. 234–241, 2016.

[19] D. Oliveira, L. A. Calixto, I. M. Fukuda et al., "Compatibility of polyvinyl chloride (PVC) medical devices and other polymeric materials with reactive ion etching (RIE) and inductively couple plasma (ICP) sterilization using a quality by design (QbD) approach," *Journal of Pharmaceutical Innovation*, vol. 13, no. 2, pp. 110–120, 2018.

[20] P. Wang, S. Wang, X. Zhang et al., "Rational construction of CoO/CoF2 coating on burnt-pot inspired 2D CNs as the battery-like electrode for supercapacitors," *Journal of Alloys and Compounds*, vol. 819, p. 153374, 2019.

[21] Y. Zhang, W. Ni, and Y. Li, "Effect of siliconizing temperature on microstructure and phase constitution of Mo–Mosi2 functionally graded materials," *Ceramics International*, vol. 44, no. 10, pp. 11166–11171, 2018.

[22] K. Oesterreichische and G. Zeitschrift, "Die Starken der Natur nutzen Endlosfaser-PVC-Composites sorgen fur uberragende Materialeigenschaften," *Oesterreichische kunststoff zeitschrift*, vol. 47, no. 3/4, pp. 56-57, 2016.

[23] A. Y. Tzivadze, A. Y. Fridman, E. M. Morozova et al., "Materials based on carbon-filled porous layers of PVC cyclam derivatives cross-linked with the surfaces of asbestos fabric fibers," *Russian Journal of Physical Chemistry A*, vol. 90, no. 8, pp. 1644–1649, 2016.

[24] D. Trichet, E. Chauveau, and J. Fouladgar, "Asymptotic calculation of equivalent electromagnetic and thermal properties for composite materials," *IEEE Transactions On Magnetics*, vol. 36, no. 4, pp. 1193–1196, 2000.

[25] J. Huang, "Empirical study on effects of different types of urbanization on consumption structure of rural residents in China," *Asian Agricultural Research*, vol. 6, pp. 30–34, 2017.

[26] D. Palumbo, R. D. Finis, G. P. Demelio, and U. Galietti, "Study of damage evolution in composite materials based on the thermoelastic phase analysis (TPA) method," *Composites Part B Engineering*, vol. 117, pp. 49–60, 2017.

[27] A. R. Ghasemi and M. Moradi, "Low thermal cycling effects on mechanical properties of laminated composite materials," *Mechanics of Materials*, vol. 96, pp. 126–137, 2016.

[28] I. Zlotnikov, E. Zolotoyabko, and P. Fratzl, "Nano-scale modulus mapping of biological composite materials: theory and practice," *Progress in Materials Science*, vol. 87, no. JUN., pp. 292–320, 2017.

[29] H. Li, Y. Gong, C. Fu et al., "A novel method to prepare a nanotubes@mesoporous carbon composite material based on waste biomass and its electrochemical performance," *Journal of Materials Chemistry A*, vol. 5, no. 8, pp. 3875–3887, 2017.

[30] B. Salvadori, E. Cantisani, M. P. Colombini, and C. G. R. Tognon, "Painted fiberglass-reinforced contemporary sculpture: investigating composite materials, techniques and conservation using a multi-analytical approach," *Applied Spectroscopy*, vol. 70, no. 1, pp. 174–185, 2016.