Taiwan Green Building Material Labeling System and its comparison with international labeling systems

Ting-Ting Hsieh¹, Che-Ming Chiang², Jui-Ling Chen³, Kwang-Pang Lai⁴

ABSTRACT
The serious energy and natural resource shortage that our living environment is currently facing shows a strong demand to develop a better building material certification and management mechanism. Following a ten-year green building material evaluation and labelling research program which started around 1998, the Architecture and Building Research Institute (ABRI) of Taiwan proposed the Green Building Material (GBM) Labeling system in 2003 and was officially launched in 2004. The GBM system aims to promote a sustainable built environment for the Earth and a healthier living quality for human beings. It was established based on the ISO15686 series, ISO21930 series, ISO14040 series, as well as the Integrated Building Performance (IBP) system proposed by the EU to ensure that the evaluation criteria and standards meet the current development trends of the world. The Taiwan GBM evaluation system incorporates low toxicity, minimal emissions, low-VOC during assembly, recycled content, resource efficiency, recyclable and reusable materials, energy efficiency, water conservation, IAQ improvement, and use of locally products, among others (Froeschle, 1999). The criteria is systematically comprised of four categories, including health, ecology, high-performance and recycling. The assessment mainly adopts the life cycle assessment approach, covering four stages of the life cycle of a building: resource exploitation, production, usage, and disposal and recycling.

This paper shows the comparison between Taiwan GBM Labeling System and other international labeling systems namely GREenguARD, BLUE ANGEL and GOODENVIRONMENTAL CHOICE in terms of program verification procedures and evaluations. The issues of indoor air quality (IAQ) (Wolkoff 1998), indoor environment quality (IEQ), and indoor environment health (IEH) have also been addressed to look further into the connection among the different labelling systems.

KEYWORDS
Green Building Material, Life Cycle Assessment, indoor environment quality (IEQ)

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1. INTRODUCTION

Entering into the 21st century, due to emerging abnormal environmental changes and severe use of energy, the whole world is rigorously devoted to finding a way to respond to issues such as energy saving, coal use reduction, and health. In Taiwan, promotion of green Building and Green Building Material (GBM) has gained considerable attention as well. Along with the international main trends, the domestic policy of Sustainable Development is now guiding Taiwan’s land development toward the direction of eco-cities with green building on the basis of human health, earth sustainability, and industry development to pursue the practical efficacy of sustainable environment. Green Building Material (GBM) is the key factor contributing to green building, healthy building, and the response to international trend of sustainability, which has undertaken the critical stand in the entire sustainable construction framework.

Following the promotion of green building evaluation and labeling more than a decade, the Architecture and Building Research Institute (ABRI) of Taiwan proposed the Green Building Material (GBM) Labeling system in 2003 and was officially launched in 2004, shown in Fig. 1. The system is aimed to promote a sustainable built environment for the earth and a healthier living quality for human beings. It was established based on ISO15686 series, ISO21930 series, ISO14040 series, as well as the Integrated Building Performance (IBP) system proposed by the EU, to ensure the evaluation criteria and standards meeting the current development trend of the world. Both global and local environmental issues, such as anticipated exhaustion of fossil fuels, increasing and fluctuating energy prices (Meadows et al., 2006), environmental pollution problems, high dependency on imported resources, high temperature and high humidity, a large amount of CO₂ emission from the building industry, as well as over 10 million-ton construction wastes generated annually, must be taken into consideration to develop a comprehensive assessment tool for green building materials.

In general, the assessment of green building materials begins with establishing criteria for evaluating the environmental performance of building materials. The criteria may incorporate low toxicity, minimal emissions, low-VOC assembly, recycled content, resource efficiency, recyclable and reusable materials, energy efficiency, water conservation, IAQ improvement, locally products, etc (Froeschle, 1999).

![Taiwan green building material label](image-url)
With extensive material usage of indoor decoration and remodeling for housing, formaldehyde (HCHO) in building materials and volatile organic compounds (VOCs) emitted in a warm environment can result in fairly high amounts risky or harmful to health (Shao et al, 2003). According to relevant research results (Wu et al., 2003), the risk values of carcinogens such as the formaldehyde in building materials and VOCs in office spaces in Taiwan are 100 to 1,000 times fold over the WHO standard, causing people to suffer from respiratory and skin diseases. The GBM system can contribute to a healthier indoor environmental quality. The issues of indoor air quality (IAQ) (Wolkoff 1998), indoor environmental quality (IEQ), and indoor environmental health (IEH) have been addressed and being further studied. From the perspective of the “Architecture Doctor (AD)” concept, now researchers and experts would diagnose causes of IEQ problems and prescribe recipes, for instance, strategies of green building and green building material application.

2. EVALUATION SYSTEM, IMPLEMENTATION AND MANAGEMENT

The major purpose of the GBM labeling system can be described in three parts: 1) promotion of high-quality and healthy life; 2) protection of ecological environment; and 3) enhancement of industry competition ability. The system focuses on the entire building quality and effective management and control of human health risk factors. Its general requirement includes basic environmental protection aspects, such as no asbestos, no heavy metal, no radioactivity, etc. The evaluation system consists of four categories of the life cycle of a building (resource exploitation, production, usage, disposal and recycling) is illustrated as Fig. 2.

![Figure 2: Framework of Taiwan green building material evaluation system](image-url)
The Taiwan GBM system is classified into four categories: Ecological, Healthy, High-performance and Recycling. Each of their standards and criteria accommodating subtropical climatic characteristics of high temperature and high humidity are also specified.

a) Ecological GBM: What is taken from nature shall be returned to nature. The building material fulfills general requirements, uses natural materials of which there is no shortage, consumes minimal resources and energy, requires less labor treatment, or possesses recycled characteristics after disposal.

b) Healthy GBM: The system focuses on the management and control of the relevant hazards, and reduce formaldehyde (HCHO) and TVOC that are added during the production of interior decoration materials, such as coding and glue preparation etc.

c) High-performance GBM: The materials and units are supposed to pass a high performance test. In order that they will be identified as high quality, they must be able to increase total efficiency without the flaws existing in conventional building materials. At present this GBM includes sound insulation, permeable paving and energy saving glass.

d) Recycling GBM: In order to reduce construction waste, and to reuse and recycle materials and achieve sustainability, the system focuses on the reuse of green building materials and improve the reuse rate of waste materials, but ensure basic functional demand.

For the practical operation of the GBM labeling system, the testing departments are national standard laboratories passing TAF accreditation. The factory owners of building materials can file the application and supply test data with TAF certification, proofs of production, ingredient and quality control, and registration document of its legality. Through the review by the Green Building Material Labeling Review Committee, suggestions of approval or rejection are given. For those who pass and obtain the green building material label conferred by the Architecture and Building Research Institute, the label is valid for 2 years and is renewable. In terms of post-market management mechanism of green building material labeling, non-scheduled spot checks are implemented to ensure the use of the GBM label and the quality of green building materials.

3. EVALUATION RESULTS AND MARKET TREND ANALYSIS

By the end of March of this year, 199 GBM Labels have been conferred covering 1,631 green products. Among these products, the healthy material occupies 77.9%, and followed by the high-performance category 14.1%, recycling 7.5%, and ecological 0.5%, shown in Fig. 3. The percentage distribution indicates the health issue has been highly emphasized and points out the development trend of the building material market in Taiwan. For a non-toxic and healthy architectural environment, as well as sound-proof and permeable function of building materials, there are 1,631 green building material products, including 592 building decoration paints, 94 wooden floors, 138 wooden boards, 103 gypsum wallboards, 161 inorganic boards,
52 organic boards, 1 rug, 5 glue preparations, 1 crack fillings, 11 soundproof door, window and wall systems, 3 floor coverings, 28 high pressure concrete ground bricks, 8 absorbent material systems, 156 permeable bricks, 73 ceramic face bricks, 3 energy saving glass, 3 aggregates and 199 PVC products. Mostly, paints ranked the highest, followed by permeable bricks, as well as wooden boards and gypsum wallboards.

![Figure 3: Percentage of four categories of GBM labeling promotion](image)

4. COMPARISON WITH INTERNATIONAL LABEL SYSTEMS

Under trade liberalization by the WTO, countries have reduced tariffs on imported goods to seek fair competence. The reduction is particularly obvious in developing countries. To maintain industry level and markets, a lot of developed countries have introduced non-tariff countermeasures, so-called technical trade barriers, to protect domestic industries. Such barriers include quality standards, technology standards, or certification of logos to maintain and protect domestic industry and market. Taiwan entered the WTO on 1 January 2002. It has been 7 years since and this has a big impact on the domestic construction industry. A lot of poor quality low price building materials were imported into Taiwan, leading to price competition and inferior quality. The Architecture and Building Research Institute, Ministry of Interior established a major mechanism—green building material certification system to distinguish the good from bad. The mechanism is successful in the construction industry in Taiwan and is gradually improving construction quality.

Over 90% of the building materials industry used to focus on the domestic market. To turn to export, they are encouraged to work under green building certification to enhance their technology to the international level. Export expansion programs by the Ministry of Economic Affairs and the Ministry of Foreign Affairs will help the transformation of factories and plants to open up to the export market and increase the market capability of the industry.

In January 2008, the Ministry of Interior promoted the Ecology City Green Building Promotion Project to cover green building materials in international exchange. Point 7 of the implementation guiding principles specifies: to continually promote green building material certification, enhance green building material certification international exchange and evaluation to achieve the international level.
Currently, contacts have been made with GREenguARD in the U.S., GOOD ENVIRONMENTAL CHOICE in Australia, ECOLOGO in Canada and DER BLAUE ENGEL in Germany to offer green building material certification information in Taiwan. Suggestions on mutual cooperation agreement have been made. ECOLOGO in Canada and DER BLAUE ENGEL in Germany are not willing to have mutual certification. GREenguARD inquired about technical questions on green building materials evaluation and testing in Taiwan, including product test time limits, test standards, test cabin operation conditions, air exchange efficiency, material sealing, VOCs and HOC chemical analysis methods, sampling timing, evaluation criteria (emission efficiency), test report validity and accrediting units.

GREenguARD certificate control covers office furniture and equipment, wall covering materials, ceilings, coatings, floors, heat and sound insulation materials, other building materials, textile products, consumer products, and cleaning products. Based on product property, certification is made on formaldehyde, VOCs, ozone, CO, NOx, CO₂, and respirable dust. Emission tests are per ASTM D 5116-97 and D 6670-01 and EPA methods. In the 32m³ cabin volume, testing is done for 5 days under 0.8 ACH under the conditions shown in Table 1:

### Table 1. GREenguARD Certification Emission Test Method

<table>
<thead>
<tr>
<th>Governing standards</th>
<th>Temperature</th>
<th>Moisture</th>
<th>Air exchange rate</th>
<th>Load rate</th>
<th>methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>GREenguARD Certification Standards for Low Emission Products for Indoor Environments</td>
<td>23°C±2°C</td>
<td>50%±5%</td>
<td>Min. 0.8±0.025h⁻¹</td>
<td>0.4 m²/m³</td>
<td>ASTM 5116-97 6670-01 US.EPA</td>
</tr>
</tbody>
</table>

Comparing with Taiwan, the methods are similar and have similar conditions in temperature, humidity (25%, 50%) and load rate (0.4 m²/m³). The difference is the air exchange rate (0.5 in Taiwan and 0.8 in the U.S.). Test time is 5 days in the U.S. and 48 hours (steady state) in Taiwan or achieved evaluation standard value.

GOOD ENVIRONMENTAL CHOICE is the Australian first category declaration environment label system. This is more similar to environmental protection label system in Taiwan. On the other hand, the GBM Label system is in the third category declaration. The building material life cycle as evaluation criteria conforms to the international environment level. Evaluation covers floor materials, coatings, ceilings, and heat insulation materials, etc, especially regarding health concern, VOCs, formaldehyde, physical factors, chemical factors and biological factors. Australian test methods are similar to ISO standards, although VOCs leaching content value differs from test cabin emission sampling in Taiwan.
5. CONCLUSION
Since July 2006, the mandatory green building material utilization has been included in Taiwan’s building code. For indoor decoration and floor materials in buildings, green building materials shall cover at least 5% of the total indoor decoration and floor material uses. Fulfilling the requirements of ecological, recycling, healthy, and high-performance attributes, the green building material regulation may effectively reduce environmental impact and improve IEQ, so as to gradually achieve “human health and global sustainability.” Starting from energy saving and resource efficiency by combining an ecological circulatory system, corresponding local environment, community civilization, as well as historic and regional features, the GBM system creates a core concept of sustainable built environment in Taiwan.
Meanwhile, local scholars and specialists’ comments on technical differences shall be organized to evaluate modification of technical systems and to seek ways to achieve the international level. Future work will continue building a connection between Taiwan Green Building Material Labeling system and international labeling and evaluation system, striving to develop an international certification mechanism, building collaboration mechanism and interchange with countries that also work on sustainable development, and further promoting the application of Taiwan’s GBM and green technology worldwide.

6. USING REFERENCES
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Relevant standards: