

**DEVELOPMENT OF A FORENSIC GLASS DATABASE SYSTEM  
EMPLOYING REFRACTIVE INDEX MEASUREMENT**

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**UNIVERSITI TEKNOLOGI MALAYSIA**

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EMPLOYING REFRACTIVE INDEX MEASUREMENT**

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*Dedicated to:*

*My lovable parents, Asmuje @ Asmuzi bin Ihwan @ Ahwan, my dearest sibling,  
not forget my supportive colleagues, AP Dr. Umi Kalthom Ahmad, Dr Roliana  
Ibrahim and Puan Nor Umizza Kamaruzaman*

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## ABSTRACT

Burglary and accident cases may involve glass fragments as physical evidence found at the crime scene. In forensic investigation, the purpose of glass analysis is to determine the origin of unknown glass. The common analysis of glass is physical examination which is thickness and color identification; and refractive index (RI) measurement as major examination. Currently, a compilation of refractive index (RI) or glass database on RI values of glass found in Malaysia is desirable and much needed by the forensic chemist. In this study, twenty samples of glass each from automobile glass, building glass and household glass were collected from various sources. Physical examination such as thickness and color were done to obtain preliminary information of the glass samples. The thickness of the glass for three classifications which is building, automobile and household according to end-use was in the range of 2-6 mm. For glass color, clear transparent was found to be commonly used in glass manufacturing followed by green, white, grey, blue and bronze colored glass. Determination of RI value was affected using Glass Refractive Index Measurement 3 (GRIM3) instrument. The classification of end-use types of glass by relating RI value and thickness of automobile glass showed 3 clusters corresponding to windscreen glass (1.5152 – 1.5225), rear screen glass (1.5147-1.5217) and side window glass (1.5188-1.5190), all samples with thickness of between 2 – 6 mm. While, building glass can be classified into heat absorbing float (1.5197 – 1.5211), clear float (1.5189 – 1.5213), figured float (1.5164 – 1.5234) and reflective float (1.5167 - 1.5188) with sample thicknesses of 2 – 6 mm. Household glass can be classified into 2 clusters. The first cluster consisted of bulb and lamp cover glasses with thickness of between 2 - 4 mm and covered a wide RI range of 1.5133 – 1.5244 while the second cluster is comprised of bottles and decorative glasses that covered a small RI range of 1.5200 – 1.5218 and larger glass thickness of between 4 – 5 mm. All informations obtained in glass analysis were used for forensic glass database. It was developed using Microsoft SQL Server Management 2008 and Microsoft Visual Studio 2008. My Forensic Glass Database System version 2011 contained 60 records of glass. It used the thickness, colors and RI values of a glass fragments to match with those stored in the database.

## ABSTRAK

Serpihan kaca merupakan bukti fizikal selalunya ditemui di tempat kejadian jenayah terutamanya bagi kes pecah rumah dan kemalangan jalan raya. Dalam penyiasatan forensik, analisis kaca dilakukan adalah bertujuan untuk menentukan asal serpihan kaca tersebut. Analisis kaca yang biasa dilakukan ialah pemeriksaan fizikal (ketebalan dan warna) dan ukuran indeks biasan yang menjadi pemeriksaan utama. Sehingga hari ini, penyusunan indeks biasan atau pangkalan data kaca yang melibatkan nilai indeks biasan kaca yang terdapat di Malaysia adalah amat diperlukan oleh ahli kimia forensik. Dalam kajian ini, dua puluh sampel kaca dari kaca kereta, bangunan dan isi rumah diperoleh daripada pelbagai sumber. Pemeriksaan fizikal seperti ketebalan dan warna telah dilakukan untuk mendapatkan maklumat awal mengenai kaca tersebut. Ketebalan kaca daripada tiga klasifikasi iaitu bangunan, kereta dan isi rumah adalah dalam lingkungan 2-6 mm. Sementara itu, warna yang sering digunakan dalam pembuatan kaca adalah lutsinar diikuti oleh hijau, putih, kelabu, biru dan gangsa. Penentuan nilai indeks biasan diukur menggunakan instrumen "Glass Refractive Index Measurement 3 (GRIM3)". Pengelasan kaca menurut penggunaannya dilakukan dengan menghubungkan nilai indeks biasan dan ketebalan kaca dapat menunjukkan 3 kelompok automobil iaitu cermin skrin hadapan (1.5152-1.5225), skrin belakang (1.5147-1.5217) dan tingkap (1.5188-1.5190) di mana semua sampel mempunyai ketebalan antara 2 - 6 mm. Selain itu, kaca bangunan boleh dikelaskan kepada "heat absorbing float" (1.5197 - 1.5211), "clear float" (1.5189 - 1.5213), "figured float" (1.5164 - 1.5234) dan "reflective float" (1.5167 - 1.5188) dengan sampel ketebalan dari 2 - 6 mm. Kaca isi rumah dapat diklasifikasikan kepada 2 kelompok. Kelompok pertama mengandungi kaca mentol dan penutup lampu dimana ketebalannya diantara 2 - 4 mm dan mempunyai kadar indeks biasan yang besar iaitu 1.5133 - 1.5244, manakala kelompok kedua terdiri daripada kaca botol dan hiasan yang meliputi kadar indeks biasan yang kecil iaitu 1.5200 - 1.5218 dan ketebalan diantara 4 - 5 mm. Semua maklumat yang diperolehi dalam analisis tersebut digunakan untuk pembangunan pangkalan data kaca forensik. Ia dibangunkan dengan menggunakan Microsoft SQL Server 2008 dan Microsoft Visual Studio 2008. Sistem "My Forensic Glass Database" versi 2011 terdiri daripada 60 data tentang kaca. Ia menggunakan ketebalan, warna dan nilai indeks biasan sesuatu serpihan kaca untuk mendapatkan padanan kaca yang terdapat di dalam pangkalan data.