DESIGNERS DATA-BASE FOR PLASTICS

A Special Project Report

by
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Guide
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APPROVAL SHEET

The special project titled "Designers Data-Base for Plastics " by Anupam Shukla is approved in partial fulfilment of the requirement for the Master of Design degree in Industrial Design

Signature of the guide

Date 14/9/88

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Anupam Shukla

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INTRODUCTION

The successful performance and profitable manufacture of any product depends on the material selected for production .The awesome growth of plastics has occurred over a very large range of load bearing applications. Most of today's plastics applications require high and sophisticated performance.

When we speak of design technology , we mean the prediction of performance, including all the characteristics and properties of a material that are essential to the process of material selection .To the designer or product engineer,a defination of property is one that permits calculation of part dimensions from stress analysis, and such properties are obviously the most desirable upon which to base material selection.

The need for systematic material selection has long been recognised .One of the increasing emphasis is on product reliability.Plastics generally are substantially lower in strength and rigidity,especially at elevated temperatures.Consequently they are designed close to their allowable limits. It has therefore,become increasingly important to know these limits, quantitatively and under actual environmental conditions

AIM OF THE PROJECT

Development of a plastic application usually requires compromising of mechanical properties such as strength,rigidity with others like electrical properties,optical clarity,permeability, processibility etc.The problem with the present system is the identification of those properties which are useful in design and performance.Exhaustive literature is available on plastics and polymers in plastic design and data hand-books.A lot of data is redundant for the designer.It is a tedious and time consuming process to go through the innumerable properties to select a plastic.It does not offer any procedure for selecting the plastic.

In this project, efforts are made to provide a data-base and develop a systematic approach to the selection of plastic material for the designer.The system will provide a quick and accurate retrieval and storage of information which can be updated when required.

DESIGN METHODOLOGY

It is important to know the methodology followed in design. It will show the stage at which material selection is done.

1)Conception of the part,leading to the initial functional design i.e.,shape of thepart and of its functional components,accompanied by selection of the basic fabrication process.

2)Screening of candidate material,on the basis of processibility and other engineering properties that relate to performance.

3)Preliminary analytical design i.e. calculations of wall thicknesses and other part dimensions.

4)Prototyping and testing under actual or simulated conditions.

5)Redesign and retesting.

6)Finalization of design and material selection .

The selection of material is the second step of design .A designer will have little idea about the numerical values of the material properties at this stage. Hence the system should provide a method by which qualitative ratings,such as high,low, poor, excellent etc. can be used for material selection along with the numerical values.

STEPS FOR MATERIAL SELECTION

1)Identification of those properties that are inherent in the materials and are not subject to enhancement by design. e.g. chemical resistance,maximum temperature,optical clarity,color or finish capability(chromeplatability). These go and no-go properties should be applied first so that the field of material can be reduced to a few.
2)Identification of processes used on the basis of production rates,size, quantities,etc.
3)Having narrowed down to a manageable no. of plastics, the designer needs to ascertain the exact values of the properties to select the right material

FACTORS FOR MATERIAL SCREENING

The following properties were selected for screening the candidate material.
1)Optical clarity
2)Chemical resistance
3)Dimensional stability
4)Mechanical properties(ductility,stiffness,etc)
5)Impact resistance
6)Water absorption
7)Dielectric strength
8)Melting temperature
9)Process temperature
10)Mold pressure
11)Mold shrinkage
12)Tensile yield strength
13)Compressive strength
14)Flexural strength
15)Special properties
The criteria for the selection is based on the kind of properties a designer looks for in the design under consideration.Apart from these properties, there are some other factors which help in screening

16)Processes(injection molding,extrusion,etc.)
17)Applications
18)Graphical representation

DOUBLE HELIX- an introduction

Double Helix is a Data-Based Information Management &Decision Support System.Double Helix is used to create a data-base for plastics and provide a systematic method for material selection.It can perform the following functions:-

1)It can create fields for information storage
2)It can create data-files
3)Enter and retrieve information
4)Search for information that meets specific criteria
5)Build an index to sort the information in a specific order.

Aperson using Double Helix should be familiar with the basic Macintosh operations.In order to work with Double Helix,one needs

* a 512K Macintosh™,Mac Plus™ or MacintoshXL™
*an external disk drive or a hard disk
*the Double Helix program diskette and system diskette
*basic knowledge of Double Helix program

DOUBLE HELIX -information

When Double Helix program is launched, it creates a **Collection.**It is within this that a collection of **Relation** is created.Relation icon serves as data storage units for sets of closely related information.Each Relation icon gives rise to six more icons-
1)**Field**-to store specific information in different formats(text,number, picture,etc.)
2)**Template**-to create forms to view and manipulate information
3)**Abacus**-to create calculations and visual programs.
4)**Query** -to retrieve a record or a set of records that meet specific criteria
5)**Selection** -to enter and retrieving the data and to select the relationships between abacus ,template,query.
6)**Index** -to arrange the information in particular order.

In data -base for plastics,the relation is named as Plastics.When this relation icon is opened,it displays a no. of Field icons,Template icon,Selection icon and Query icon.Each Field icon corresponds to a particular property or plastic name or an application or process and is named after it.The Template icon is named as Property Form and contains a form in which the Field icons are placed against their corresponding names in adjecent columns.The Selection icon is named as Property Values.The Query icon is named Enquiry.

HOW TO USE THE PROGRAM

A)For information retrieval

Steps:-

1)Launch Double Helix by double-clicking on the **Plastix Data-Basix** icon.

2)Open **File** menu and select **Show Collection.**

3)Double-click on **Plastic** relation icon .

4)Scroll to find the **Enquiry** query icon and double-click to open it.

5)Click on a specific field to ask questions.

6)Give the values of the search parameters in the dialogue box in the format specified.

7)Close the dialogue box by clicking the close box.

8)Select other fields to ask questions and repeat step no. 6 and no. 7

9)Close the **Enquiry** window.

10)Double-click on the **Property Values** selection icon.

11)Open **View** menu and select **Show Selection.**

12)Click on the words **'Property Form'** under the template icon and **'Enquiry'** under the query icon.

13)Open **View** menu and select **Find First,Find Next** and so on .

14)Continue till all the information is retrieved.

B)For updating information

1)Repeat steps 1 to 3 in (A)

2)Scroll to find the **Property Values** icon and double -click .

3)Open **View** menu and select **Clear Form**

4)Click the pointer in the'**Name'** field to select it

5)Open **View** menu and select **Quick Query**

6)Give the name of the plastic in the dialogue box whose data needs updating.

7)Open **View** menu and select **Find First.**

8) Make changes and press **Replace**

C)To store new data

1)Follow steps 1 to 3 as in (A)
2)Scroll to find **Properties Values** and double-click
3)Open **View** menu and select **Clear Form**
2) Enter the data in each field and press tab to go to the next field
3)Press **Enter** key or select **Enter** from the**View** menu

NAME(grade)	ABS-G.P.HIGH IMPACT INJECTION MOLDING
OPTICAL CLARITY (h/l;transmittance value;%haze value)	LOW;72;10
CHEMICAL RESISTANCE (h/l resist. to acids &/or bases,solvents)	HIGH RESIST. TO ACIDS & BASES,SOLUBLE IN POLAR SOLVENTS LIKE ESTERS,KETONES;GOOD OVERALL CHEMICAL RESIST.
DIMENSIONAL STABILITY AT HIGH TEMP. (h/l;value of coeff. lin. th. exp. (10exp.-6/c))	LOW,95-110
PROCESSES (injection,extrusion,blow molding,casting, compression,rotomolding,thermoforming)	INJECTION,EXTRUSION,ROTOMOLDING,BLOW MOLDING,COMPRESSION
MECHANICAL PROPERTIES (ductility,stiffness,rigidity,toughness,.)	DUCTILE AT LOW TEMP.,TOUGH,RIGID
SPECIAL PROPERTIES (e.g.:colorability,weatheribility,etc.)	FLAME RETARDENCY,TRANSPERANCY(USING MMA), ELECTROPLATABILITY,LOW &HIGH GLOSS FINISH,FOAMABILITY
IMPACT RESISTANCE (h/l;izod value)	HIGH;6-9.3
WATER ABSORPTION (h/l;%value)	LOW;0.2-0.45
DIELECTRIC STRENGTH (h/l;value in V/mili.)	HIGH;350-500
MELTING TEMP. (range value in C)	100-110
PROCESS TEMP. (range value in C)	C:325-350,I:380-525
MOLD PRESSURE (range value(10exp.3 p.s.i.))	8-25
MOLD SHRINKAGE (value)	0.004-0.009
TENSILE YIELD STRENGTH (value(p.s.i.))	2600-5900
COMPRESSIVE STRENGTH (value(p.s.i.))	4500-8000
FLEXURAL STRENGTH (value(p.s.i.))	5400-11000
APPLICATIONS	AUTOMOTIVE & HOUSEHOLD APPLIANCES;PIPES &FITTINGS FOR DRAINS, VENTS,ELECTRICAL CONDUITS;ELECTRONICS,COMM. & BUSINESS M/CS;REFRIGERATOR TANKS &DOOR LINERS;LUGGAGE; SPORTS ITEMS;REPLACEMENT FOR METALLIC KNOBS;DECORATIVE ITEMS
COMMENTS	
GRAPH	

NAME	NAME
OPTICAL CLARITY(H/L)	opt clar
TRANSMITTANCE	trans value
HAZE %	haze
CHEMICAL RESISTANCE	chem resist
DIMENSIONAL STABILITY(H/L)	dim stab
COEFF. LIN. TH. EXP.(10 EXP-6/C)	max th exp
MOLD SHRINKAGE(H/L)	mold shr
MAX SHRINKAGE	max mold shr
MIN SHRINKAGE	min mold shr
WATER ABSORPTION(H/L)	water abs
MAX ABSORPTION %	max water abs
MIN ABSORPTION%	min water abs
PROCESS METHODS	process
MAX MELTING TEMP. C	max melt T
MIN MELTING TEMP. C	min melt T
MAX PROCESS TEMP. C	MAXprocessT
MIN PROCESS TEMP . C	MINprocess T
MAX MOLD PRESSURE C	max pr
MIN MOLD PR	min pr
MECH. PROPERTIES	mech prop
MAX TENSILE YIELD ST p.s.i.	max ten st
MIN TEN YLD ST p.s.i.	min ten st
MAX COMPRESSIVE ST p.s.i.	max comp st
MIN COMP. ST p.s.i.	min comp st
MAX FLEXURAL ST p.s.i.	max flex st
MIN FLEX ST p.s.i.	min flex st
MAX IMPACT RESISTANCE	max imp resis
DIELECTRIC STRENGTH(H/L)	di elec prop
MAX DIELEC ST	max dielec
MIN DIELEV ST	min dielec
APPLICATIONS	appli
SPECIAL PROP.	spl prop
GRAPH	graph

FUTURE SCOPE

Using the DOUBLE HELIX program a report can be created in which few properties of the final selected plastics can be compared and analysed.The numerical data can be arranged in increasing or decreasing order.This will not only help in comparision but also in further narrowing down to a smaller group of plastics.
Due to non-availability of Double-Helix manual and time constraint this aspect of the project could not be explored.

By selecting the relation

REFERENCES

1)Modern Plastic Encyclopedia 1984-85
Mc Graw Hill Inc.
ch 1-Textbook
Materials Pg 6-94
ch 2-Design Guide
ASystematic approach to plastics material
selection and design Pg 404-406
ch 3-Data Bank
Property Charts -resins and compounds Pg 450-481
Design data chart - dimensional stability Pg 565-575
- optical properties Pg 591-593

2)Plastic Product Design Handbook
Part A, Materials & Components
by Edward Miller