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STUDYING THE INHIBITION OF AGING OF POLYPROPYLENE

Annotation: In this research we are studying the effects of the stabilizer Chimassorb 944 on Polypropylene according to different averages starting from 0% to 1.4% of Chimassorb 944.

Through this study we came to a conclusion that adding Chimassorb 944 to Polypropylene inhibits the aging process very affectively in the Syrian environment. And the percentage 0.6% is the most convenient in the case of Polypropylene .

Key words: Polypropylene , Aging, stabilizer Chimassorb 944.

ИССЛЕДОВАНИЕ ОБСТРУКЦИИ ПОЛИПРОПИЛЕНА

Аннотация: В этом исследовании влияние Химассорб 944 на полипропилен оценивалось в соответствии с различными соотношениями в диапазоне от 0% до 1,4% Химассорб 944. Исследование показало, что добавление С944 к полипропилену эффективно противостоит процессу старения в сирийской среде, и 0,8 является наиболее подходящим.

Ключевые слова: полипропилен, старение, химассорб 944.

1: Introduction and the Research Objective:

Plastic materials are part of everyday life. Due to their unique properties, they are used in different areas ranging from packaging materials

over components in the automotive industry, electronic devices, thermal, or electrical insulation, to special applications as for instance encapsulation materials used in photovoltaic modules. [1.c,1368]

Thus, it is not surprising that the annual production of polymers approaches 200 million tons and 50% of the chemists in USA, Japan or Western Europe work in one way or other with polymeric materials. [2.c,8]

Today's polymer industry is one of the fastest growing and promising industries in the world. Polymer stabilization has been an active area of research and development for several decades. [3.c,197] The increasing cost of polymers coupled with an increasing concern over the environmental impact has resulted in a number of studies on utilization of plastic wastes. Recycled polymers are already used in the polymer industry. Thermo oxidative degeneration of polymer chains as a result of recycling the plastic is one of the most important factors that could reduce the stability of plastic products, especially at high temperature. [4.c,1003], Aging of polymeric materials may be defined as a progressive deterioration of the physical properties due to the action of heat, oxygen, radiation, or mechanical work, either separately or in combination .[5.c,2969]

Therefore, the aim of the study was to study the inhibition of aging of Polypropylene by using an antioxidant and to find an economically appropriate antioxidant ratio.

2: Additives for polymers:

Fillers, coloring materials, stabilizers, and antioxidants.

3: Polymer aging and photolysis:

The deterioration of the physical, chemical, and/or aesthetic properties of polymers which may occur during processing or subsequent usage has been the subject of long-standing interest and concern to polymer producers. [6.c,319]

The physical changes occurring in plastic materials exposed to natural conditions can be caused by a variety of both non-biological and biological factors. [7.c,103]

4: Stability of polymers:

The inhibition of polymer oxidation via free radical reaction with molecular oxygen is the main goal of the increase in material durability when the fabricated polymer products are subjected to various environmental conditions. [8.c,6949]

5: Classification of antioxidants:

Antioxidants are commonly classified according to their protection mechanism into two main categories: primary antioxidants which trap free radicals, and secondary antioxidants which decompose hydroperoxides into more stable molecules. Antioxidants and stabilizers can also be classified chemically into four main groups: hindered phenol, phosphites, thiosynergists and HALS. [9.c,112]

6: Experimental section:

6-1: The Chemical Material Used

- Chimassorb 944 Poly [[1,1,3,3-tetramethylbutyl] amino] -1,3,5-triazine-2,4-diyl] (2,2,6,6-tetramethyl-4 -piperidiny] imino] -1,6-hexanediyl [(2,2,6,6-tetramethyl-4-piperidiny] imino))] 100% purity, partial weight 2000 g / mol, melting point 136- 140 ° C, CAS: 71878-19-8, from Sikma Aldrich, produced ins USA.

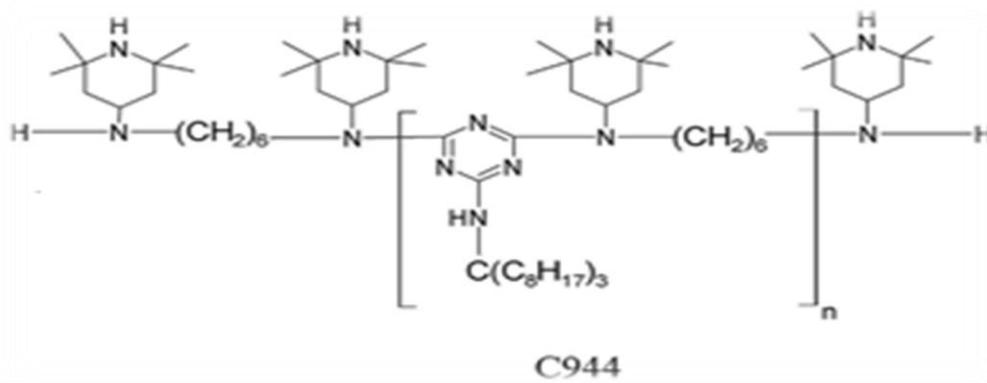


Figure 1. Chimassorb 944

• Low density polypropylene, SABIC produced in Saudi Arabia, Molecular Weight 520 g / mol, 95% purity.

7: Results and discussion:

7-1: Study of the IR spectrum of Chimassorb 944:

A sample was taken from: Chimassorb 944

The sample was measured in a solid way and the following spectrum was recorded:

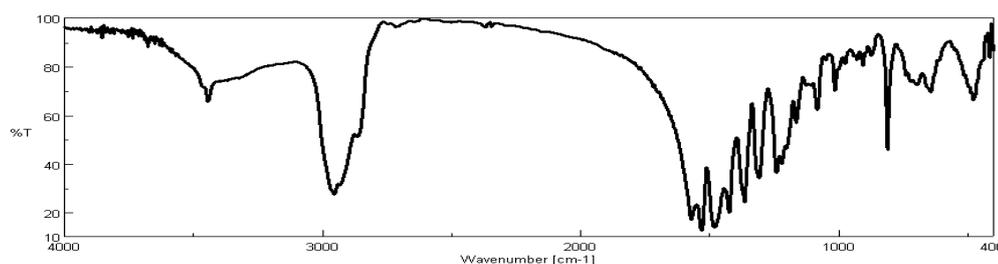
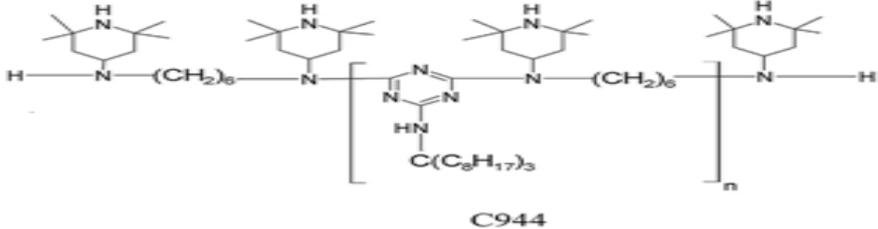


Figure 2. IR spectrum for Chimassorb 944

Table 1.

Interpretation of infrared spectra of Chimassorb 944

									
C-H ₂	C-N	CH ₃	CH ₂	C-H	N-H	N-H	CH ₂	N-H	Functional Group
bend	bend	bend	bend	bend	bend	bend	stretch	stretch	The corresponding stretching cm-1
810	1240-1163	1364	1423	1481	1531	1570	2954	3443	

7-2 : Effect of Chimassorb 944 on Polypropylene:

7-2-1: A Sample of polypropylene without Chimassorb 944:

The sample, which is 10 g of Polypropylene, is formed with a thickness of 0.1 mm and placed under the sun.

Ten days later we recorded the following spectrum:

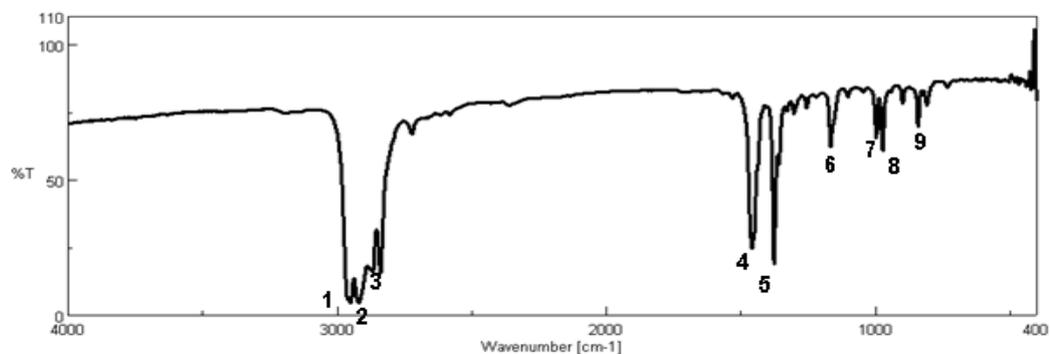


Figure 3. IR spectrum of Polypropylene compound (first measurement)

Table 2.

Interpretation of IR spectrum of polypropylene compound

				
Isotactic Polypropylene Band	CH ₃ Band	CH ₂ Band	CH Stretch	Functional Group
6-7-8-9	5	4	1-2-3	Top number
1166-997-972-840	1375	1457	2951-2920-2838	The corresponding stretching cm-1

Note that a C = O peak does not appear, ie, no aging begins.

Third measurement: Twenty-five days after the experiment began, the following spectrum was taken:

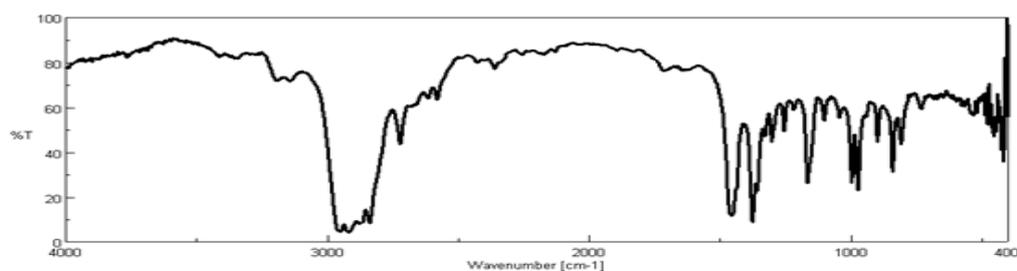


Figure 4. IR spectrum of polypropylene (third measurement)

The onset of aging is observed in the spectrum when a peak has appeared at 1712 Cm^{-1} .

Different several spectra were taken at equal separated times, including:

Seventh measurement: Forty five days after the experiment began, the following spectrum was taken:

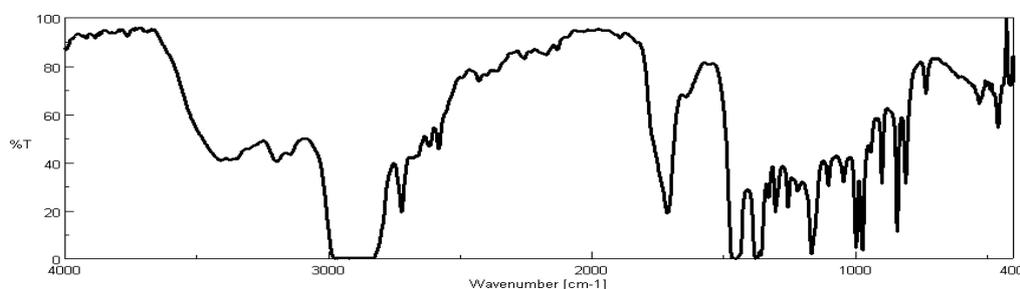


Figure 5. IR spectrum for polypropylene (Seventh measurement)

Here the sample is completely obsolete.

The following figure shows the shifts of the $\text{C} = \text{O}$ peak due to aging.

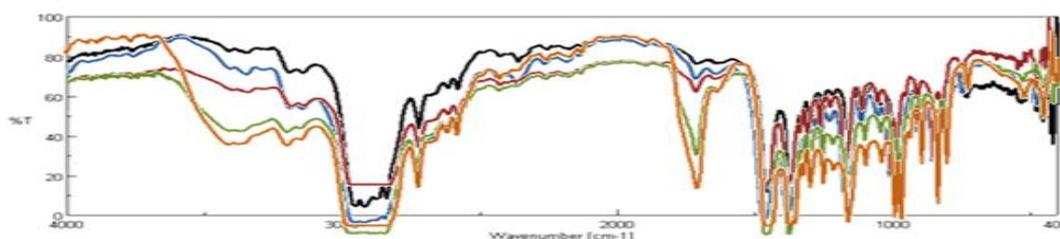


Figure 6. IR spectrum overlay of polypropylene

7-2-2 :A Sample of polypropylene containing Chimassorb 9440 by 0. 2%:

Here a sample of polymer is mixed with Chimassorb 944 by 2%.

A number of measurements were taken and no aging occurred. At the fourth measurement after thirty-five days, the following measurement was taken:

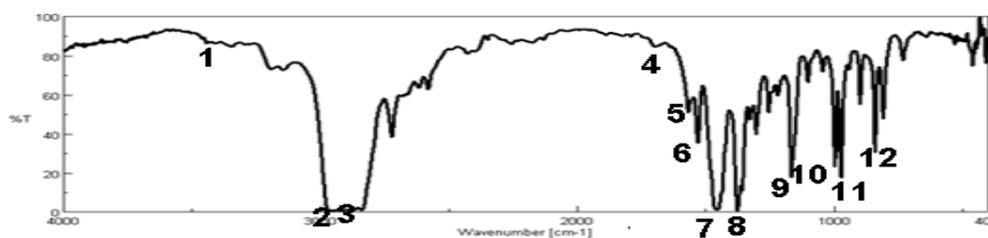
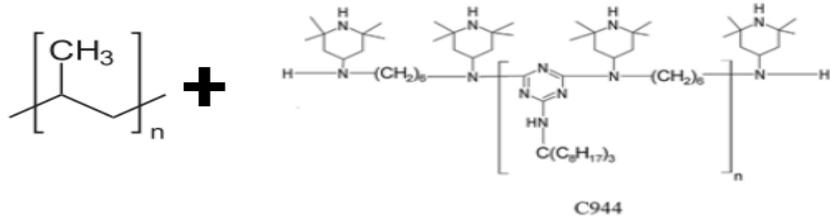


Figure 7. IR spectrum for combination of PP + C944 concentration of 0.2%

A peak is observed at 1715 Cm^{-1} , which shows the onset of aging.

Table 3.

shows explanations of the previous peaks

							
Isotactic Polypropylene Band	CH3 Band	CH2 Band	N-H Band	C=O Band	CH Stretch	NH Stretch	Functional Group
9-10-11-12	8	7	5-6	4	2-3	1	Top number
1166-997-972-840	1375	1459	-1567 1531	1715	2951-2920- 2838	3443	The corresponding stretching cm-1

Different several spectra were taken at equal separated times, including:

Tenth Measurement: Sixty-five days after the start of the experiment, the following spectrum was taken:



Figure 8. IR for combination of PP + C944 0.2% (Tenth measurement)

This measurement corresponds to the expiration of the aging and the fragmentation of the sample.

All the previous spectra can be compared in this figure:

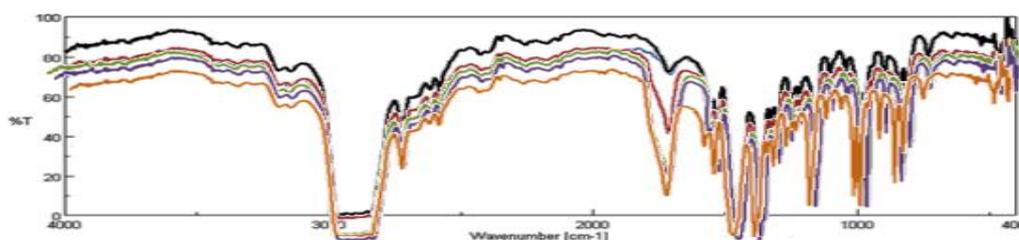


Figure 9. IR spectrum overlay for PP + C944 concentration 0.2%

7-2-3: A Sample of polypropylene containing Chimassorb 9440 by 0.4%:

Several measurements were taken and there was no aging. On the 40th day, the fourth measurement was taken and the beginning of aging occurred.

The following spectrum was taken:

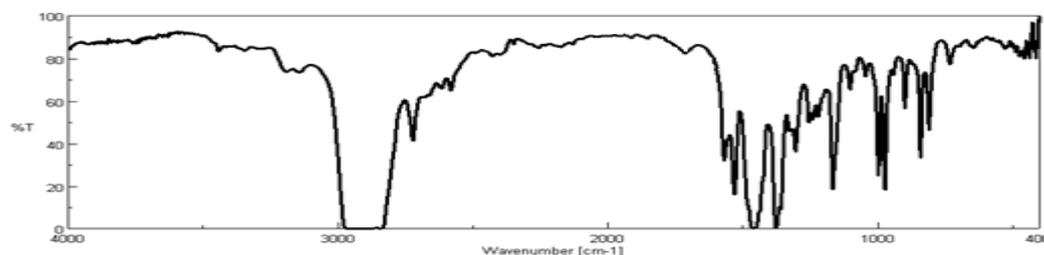


Figure 10. IR for the combination of PP + C944 0.4% (fourth measurement)

A peak at 1720 Cm^{-1} appears to indicate aging.

Different several spectra were taken at equal separated times, including: **Ninth measurement:** Seventy-five days after the start of the experiment, the following spectrum was taken:

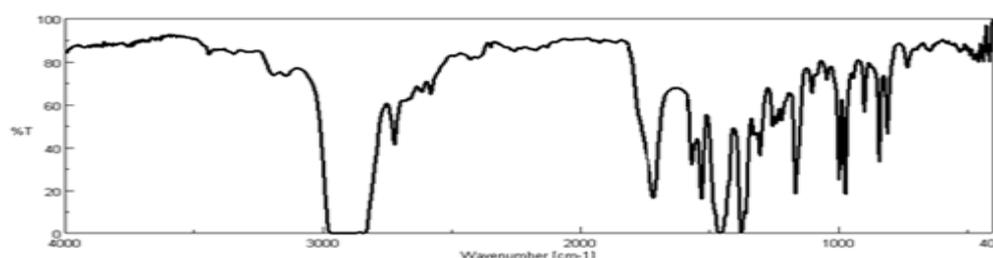


Figure 11. IR for the combination of PP+C944 0.4%

7-2-4: A Sample of polypropylene containing Chimassorb 9440 by 0.6%:

Several measurements have been taken and no aging has occurred. At the 50th day, the sixth measurement was taken and the beginning of aging occurred. The following spectrum was taken:

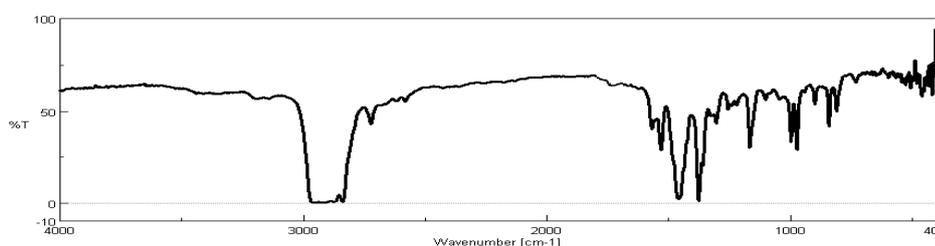


Figure 12. IR for the combination of PP + C944 0.6% (sixth measurement)A peak at 1725 Cm^{-1} is observed.

Different several spectra were taken at equal separated times, including

Twelfth measurement: Eighty days after the start of the experiment, the following spectrum was taken:

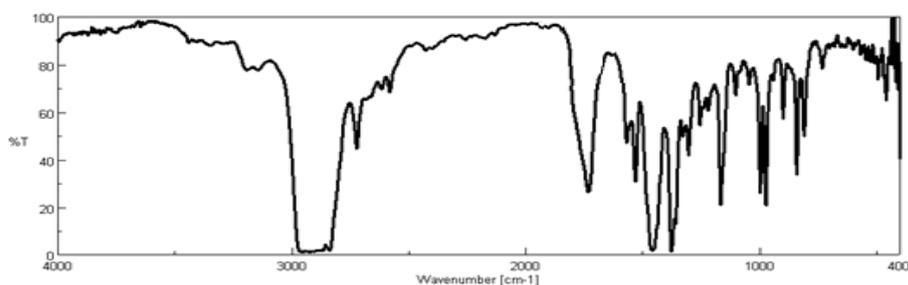


Figure 13. IR for the combination of PP + C944 0.6% (XII measurement)

At this measurement, the aging is over.

7-2-5: A Sample of polypropylene containing Chimassorb 9440 by 0.8%

Several measurements were taken and there was no aging.

At the 65th day, the seventh measurement was taken and the beginning of the aging occurred. The following spectrum was taken:

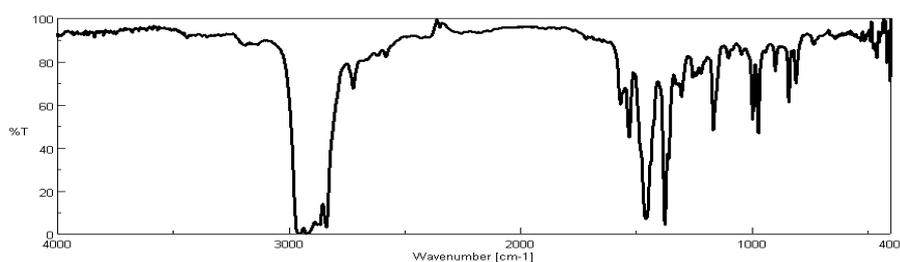


Figure 14. IR spectrum for PP + C944 concentration 0.8% (seventh measurement) Different several spectra were taken at equal separated times, including:

Fourteenth measurement: One hundred days after the start of the experiment, the following spectrum was taken:

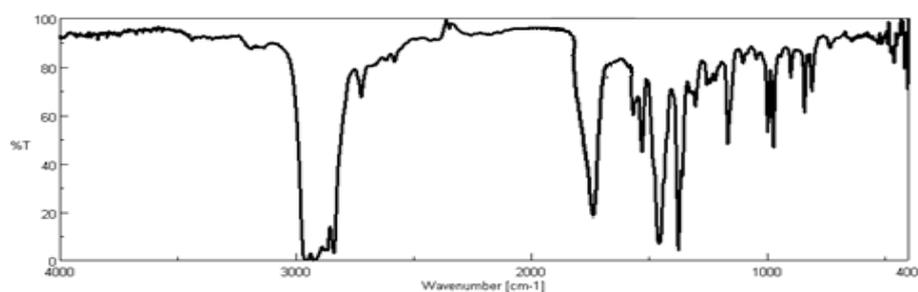


Figure 15. IR for PP + C944 concentration 0.8% (measurement XIV) This measurement shows that the sample is fragmented.

7-2-6: A Sample of polypropylene containing Chimassorb 9440 by 1%:

Several measurements were taken and there was no aging.

At the eighty-fifth day, the ninth measurement was taken and the beginning of aging occurred. The following spectrum was taken:



Figure 16. IR for the combination of PP + C944 1% (measurement IX)

Different several spectra were taken at equal separated times, including:

Fifteenth measurement:

One hundred and five days after the start of the experiment, the following spectrum was taken::

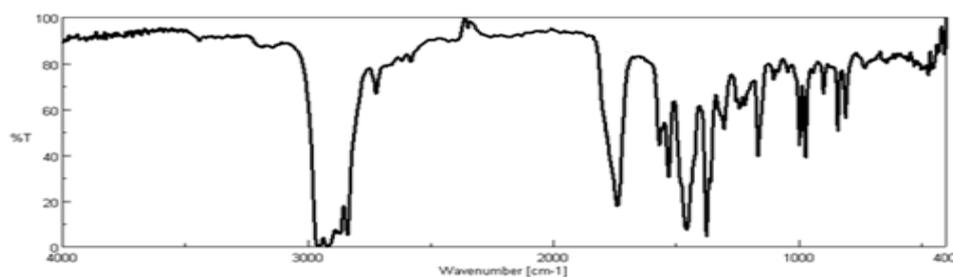


Figure 17. IR for the combination of PP + C944 1% (measurement XV) At this measurement, the aging is completely exhausted.

7-2-7: A Sample of polypropylene containing Chimassorb 9440 by 1.2%:

A number of measurements have been taken and there has been no aging. One hundred and ten days after the start of the experiment, the eleventh measurement was

taken and the beginning of aging occurred. The following spectrum was take:



Figure 18. IR for the combination of PP + C944 1.2% (measurement XI)

Different several spectra were taken at equal separated times, including:

Sixteenth measurement:

One hundred and thirty five days after the start of the experiment, the following spectrum was taken:



Figure 19. IR for the combination of PP + C944 1.2% (measurement XVI)

The sample aging at this measurement is complete.

7-2-8: A Sample of polypropylene containing Chimassorb 9440 by 1.4%: A number of measurements were taken and there was no aging. One hundred and thirty five days after the start of the experiment the fourteenth measurement was taken. The beginning of aging occurred. The following spectrum was taken:

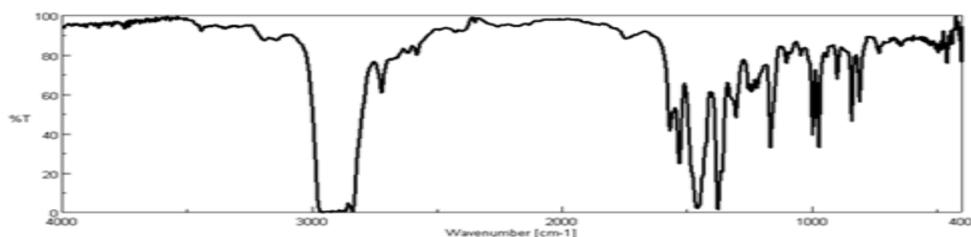


Figure 20. IR for the combination of PP + C944 1.4% (measurement XIV)

Different several spectra were taken at equal separated times, including:

Nineteenth measurement:

One hundred and sixty days after the start of the experiment, the following spectrum was taken:



Figure 21. IR for the combination of PP + C944 1.4% (measurement XIX)

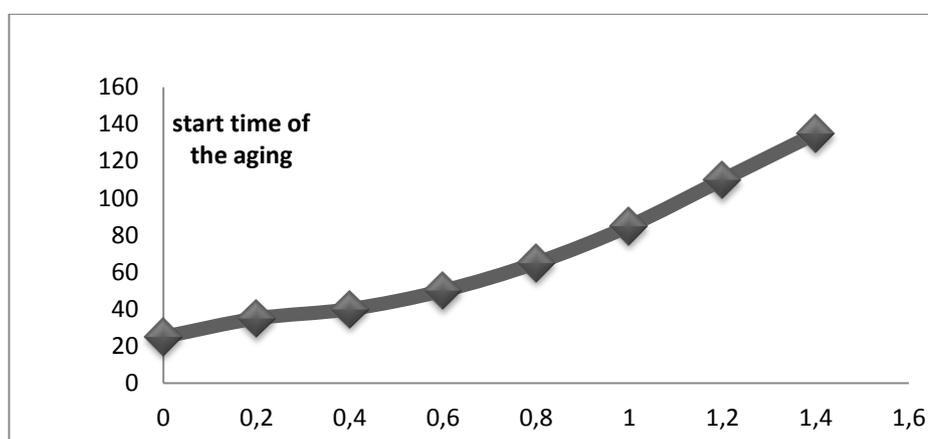
The sample aging at this measurement is complete

Table 4.

shows the start and end time of the aging of the polypropylene samples with C944:

1.4	1.2	1	0.8	0.6	0.4	0.2	0	sample mesure
10	10	10	10	10	10	10	10	1
10	10	10	10	10	10	10	10	2
10	10	10	10	10	10	10	5	3
10	10	10	10	10	10	5	5	4
10	10	10	10	5	10	5	5	5
10	10	10	10	5	10	5	5	6
10	10	10	5	5	5	5	5	7
10	10	10	5	5	5	5		8
10	10	5	5	5	5	5		9
10	10	5	5	5		5		10
10	10	5	5	5				11
10	5	5	5	5				12

10	5	5	5					13
5	5	5	5					14
5	5	5						15
5	5							16
5								17
5								18
5								19
135	110	85	65	50	40	35	25	start time aging
160	135	115	100	80	75	65	45	end time aging



8: Conclusions:

-The aging of the previous samples was followed by a solid IR method, It was found that a polypropylene sample with a 0.8% ratio of Chimassorb944 is economically most suitable.

9: ACKNOWLEDGEMENT:

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