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1984

Mexico.

REPORT OF ALLAN L. GRIFF -- Consultant in Plastics Extrusion
Plastics in Agriculture. -- Post DP/MEX/78/017/11-84/32.1.H

What Was Done

The writer spent two weeks in Mexico working with the Center for Applied Industrial Chemistry (CIQA) in their Plastics-in-Agriculture project. This is a joint effort of CIQA (a government-sponsored research institute), PEMEX (the national petroleum group) and UNIDO. The intention is to develop and disseminate reliable information that would increase the use of plastics in agriculture.

The two weeks were spent as follows:

a) Meeting with CIQA people at their base in Saltillo, discussing current status of agroplastics use in Mexico, specific products and problems, and laboratory equipment available at Saltillo.

b) Attendance at annual meeting of COMEPA, the Mexican agroplastics association, in Culiacán. There were 15 technical presentations (see program attached), plus visits to a maker of plastic film, a farm where such film was being used as mulch, and a packer of vegetables grown with plastics assistance. Also, we visited an excellent demonstration of plastics at a local agricultural research station, complete with model tunnels and greenhouses, plots of vegetables growing with mulch film, actual mulch-laying machines in operation, and samples of other plastics uses such as irrigation pipe, netting, sacks, sprinklers and field boxes for harvest. (See enclosed Item 2.) The timing of this meeting was fortunate, as it gave an opportunity to meet and talk with key people in this field from all over Mexico.

c) Visit to Plasticos de Culiacán, a film maker, to see machinery in production and discuss technical questions.

d) Visit to Agrotilenc, another film maker, in Guadalajara, where we also saw machinery in operation and discussed problems in making very wide and thick film that is desired. A separate report was written for them (see Item 3 enclosed).

d) Brief visit to Mexico City, to meet Mr. Steen, the UNIDO man that has been working with this project.

e) Visit to Petroplasticos in Reynosa, a new company making film for agricultural uses; most equipment not yet in operation, discussed plans, saw experimental fields and model greenhouse.

All visits except the one to UNIDO/Mexico City were in the company of Ing. Sergio Montes, the CIQA man most closely involved in this work. He was very cooperative and helpful, as well as technically competent.

Specific Topics

1. This was an introductory visit. The mission was originally scheduled for a month, but was divided in two to get an earlier starting date. This turned out to be a good idea for other reasons: it enabled me to attend the COMEPA meeting, it gave us the chance to talk directly about what I could do for the Plastics-in-Agriculture project, and it now leaves adequate time to prepare for some proposed activities (seminars, translations). We have tentatively planned the second half for March or April, and I am to suggest possible dates to CIQA for their consideration.

2. Importance and Viability of the Project. Plastics in Agriculture is certainly an important subject for study and effort. It is well-organized on an international level, with national associations in many countries such as Mexico's COMEPA. Nevertheless, Mexico is far behind in its amount of plastics used, according to figures presented at the Culiacán meeting. Realizing this potential is desirable, both to expand Mexican industry and to increase its food production.

CIQA is a good place for plastics-in-agriculture activity, at least for the plastics side. (There should be, and there are, people from the agricultural side working in this area, too.) CIQA's Plastics laboratory facilities are good, and contain most of the equipment needed to study practical application of polymers. Also. its people seem practically oriented -- this is needed to overcome the theoretical orientation that can easily inhibit commercial application of any work done. The key letter in CIQA'a name is the "A" for "applied." To be effective, any such organization must select and direct its efforts with awareness of the commercial and political world around it. Otherwise, it may look good for having tried, but the real measure of success will be the increase in tonnage of plastics used in agriculture from year to year.

To help increase these figures, CIQA and/or some cooperating organization must work to develop markets as well as the technical bases. This has three aspects:

a) development of application information, such as expected service life, how to apply mulch or build greenhouses, quantities of water saved with drip irrigation, and the like, always with realistic cost information based on actual experience if possible.

b) communication of information to enough of the right people in an easily-understood, "digestible," way.

c) a feedback loop -- enough contact with the marketplace to guide the development and communication efforts.

I was not at CIQA long enough to ascertain how well these functions were being carried out, but the people there are certainly aware of them.

Regarding the communication function, there may be a need for more intensive publicity. I saw no publications for general distribution

in Mexico on agroplastics, other than suppliers' literature or technical articles. Perhaps there are indeed such publications, but what I am looking for are little booklets for farmers and the banks that finance them, printed by the hundreds or more, and given at no cost to all who might be interested, perhaps via regional farmers' organizations. Another example of publicity could be a televised visit to the Culiacán demonstration noted above, where all the agroplastics uses could be seen, with a reporter asking questions of someone from COMEPA.. We should be talking at farmers' meetings as well as asking them to come to ours. Working closely with a few firms may be a good idea, but only as a means to the end of a large increase in agroplastics usage in Mexico.

3. Recovery and Re-use of Film. This is an important issue for both technical and economic reasons, for film used as mulch and in construction of greenhouses and tunnels. In the choice between degradable and recyclable mulch, I favor recycling for both environmental and economic reasons. As for tunnels and greenhouses, their life is determined by economics and climate: thicker film and/or more protective additives mean more cost and longer life.

The development and communication of recycling technology should have a high priority in CIQA's plastics-in-agriculture work. This means answering such questions as:

a) how is used film best chopped, cleaned and reprocessed?

b) at what percentage can it be safely used to make new film for agroplastics?

c) what effect does the inclusion of reprocessed film have on the properties of the resultant new film?

d) can recovered film be used for other products, such as tomato poles or irrigation pipe?

e) what additives, if any, can be added at what cost, to regain the original properties?

Recovery of film no longer useful in the field is essential to the economics of agroplastics. Recycling is best done by the film makers themselves. They aleady have extrusion equipment and experience, but an intermediate collection agency may be appropriate in certain areas. With such recovery operating on a cost-effective basis, we can offer a less expensive product to farmers, and such lower cost should lead to more total usage and more total benefit.

This is not a new idea, but new developments in film recovery are appearing rapidly now. I gave copies of some recent articles to CIQA and some of the people we visited, and will be sending more. The agroplastics groups in other countries, too, should have relevant information, and this is a good example of the benefit to be derived from increased contact among such groups.

4. Making Black Concentrates. Carbon black is by far the most effective and cheapest protector of plastics against the weakening effects of sunlight, and black films are therefore commonly used in mulches. The degree of dispersion is important in effective use of the black pigment, and CIQA is properly studying this question. Some of the larger film makers may be able to make their own concentrates of carbon black -- mixtures with polyethylene that are later diluted to final concentration of around 2% -- but there are already some good suppliers in Mexico. The making of the concentrate is a critical step, and CIQA's efforts to establish some type of standards and tests will be useful to help both suppliers and in-house makers to do a good job. The quality is a combination of the nature of the pigment that is used and the mixing and extrusion technology that is applied.

5. Geographic and Crop Limitations. CIQA's work is centered in the North and Central portions of the country, mainly aiming at producers of vegetables for export. While this is highly worthwhile, there are other potential uses, too; in specific, I was surprised by the huge potential for plastics use in coffee-growing, mentioned by oneof the COMEPA meeting speakers, and defended even when questioned by someone in the audience. Also, I did not see any mention of the use of plastics in subsistence or village-level agriculture for the farmers' own consumption. We did talk briefly about the suitability of mulch for basic grains and even saw an experimental plot in Reynosa, so perhaps such work is being done.

Recommendations for Further Work

How can I further cooperate with CIQA in their efforts? The following were all discussed with CIQA personnel, mainly Ing. Montes, in the course of our travel together:

1. Completion of the second half of this mission, to be done around March-April 1985. At this time, CIQA would schedule a seminar on the technology of extrusion, similar to the one I regularly give in the USA, but done in Spanish, and with heavy emphasis on agricultural uses such as film and pipe. This would be a two-day seminar, at the level of a basic engineer or production manager, and would be supported by the same technical information and notes that I already use, which CIQA would selectively translate as needed. They also will translate my basic manual for extrusion training, which I wrote and use in my own work regularly. There is also the possibility of a shorter one-day seminar aimed at foremen and other non-technical people, either at CIQA headquarters in Saltillo, or at several locations elsewhere.

I am prepared to follow CIQA's direction as to length, scope and number of seminars, as they see fit. If these things are decided soon, there is enough time between now and the spring to prepare for these seminars properly, which means selection of locations, arranging for details such as lunches and transportation, and getting out enough publicity so that everyone who might be interested will know about it well in advance, and thus has a chance to attend.

As an additional feature, we may add an extra day to the primary seminar during which attendees can discuss specific questions and technical problems on a one-to-one basis.

In addition to these seminars, I would expect to visit some of the firms I already saw on this trip, and perhaps others that CIQA considers appropriate.

2. Assistance in expansion to other areas of agroplastics. Current work is concentrated in film, as this is the most important of the agroplastics markets. However, there is much interest also in pipe for irrigation, netting for plant protection, crates for transport and collection, and other items. Pipe and netting are extruded products, and I have worked extensively with them. Also, the packaging of food is integrally linked with its production, and food packaging is another area where I could be of assistance. These things cannot be done in the short period of my next visit, but may be considered as subjects for future cooperative work.

3. Support from USA. Now that a good contact has been established, there are many things I can do from my own offices that would help CIQA'S work, such as reporting new advances from US conferences and trade shows, getting information from US machinery suppliers, etc. I already will do some of this to help the people we visited (e.g., getting specifications of their equipment that US suppliers never gave them, getting samples of commercial purge compounds). If such service is desired on a more continuous basis, a suitable arrangement will be possible.

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Translations of titles of presentations at COMEPA meeting, Nov 29-Dec 1, 1984, Culiacán, Sinaloa, Mexico

1. Development, yield and water consumption for calabacitas (little squash) in greenhouses -- Celina Maeda of Pronapa.

2. Effect of plastic mulch on water efficiency and plant development for melons -- Josefina Martínez.

3. Plasticulture, from raw material to film -- Galo Carretero, private consultant. Shows problems with film for greenhouses, with both PVC and polyethylene, including installation errors.

4. Raw material and its quality control (PVC) -- Humberto Goyri. Shows properties of resins and compounds for pipe and films.

5. Modified tunnel greenhouses of polyethylene -- Roberto Peralta. Shows different cross-sections, favors an arch top with sidewalls.

6. Microtunnels: their influence on early harvest, yield, quality of fruit and disease incidence, for melons -- Manuel Astorga. The microtunnels (a few feet high), as expected, helped in all these aspects.

7. Irrigation with plastic elements-- Amos Tichauer, Israeli engineer working in Mexico. Showed advantages of drip irrigation, including using single line for many rows by rolling up and replacing.

8. New systems of financing of plastics in agriculture -- Lisandro Fernández (FIRA, government agency) and Leonel Garza (Banpais, a bank). Reported statistics on how much is financed, gave very little on the actual financing conditions, described application procedure.

9. Evaluation of plastic films -- Eduardo Ramírez and Marco Uresti (CIQA). Promotion of idea of standards for agroplastic materials.

10. Processing and control of low-density polyethylene for agricultural use -- Santiago Sanchez of CIQA. Shows how impact strength and transparency depend on processing temperature, blow-up ratio, etc.

11. Design of agricultural films: analysis of relations among cost, useful life in the field and thickness -- Virgilio González and Guillermo Lozano (CIQA?). Relates effects of stretching of film in extrusion, considers balanced/unbalanced films, interesting graphs of hours to make 1 hectare's covering and cost/hectare, vs thickness.

12. Selection and quality control of resins for agricultural use -- Sergio Montes, CIQA. Compares three polyethylenes, deals with shear behavior, elastic recovery, swelling.

13. Experience with plastic mulch -- José Hernández (CIQA). Gives statistics of what countries use how much, where potential is in Mexico (notes huge potential for coffee).

14. Bagging tomatoes in polyethylene film -- René Peralta (CIQA). Control of gases -- CO_2, O_2 and ethylene to gain shelf life, used fungicides, too.

15. Plastics in semiforcing of agricultural products -- Marco Uresti (CIQA). Used clear and black mulch, some with PVC small tunnels, reports results with watermelon and kenaf (fiber).

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III CONGRESO NACIONAL DE PLASTICOS PARA LA AGRICULTURA

El Comercio

PROGRAMA TECNICO:

COMITE MEXICANO DE PLASTICOS EN LA AGRICULTURA, A. C.

Jueves 29 de Noviembre de 1984

15:30 a 15:45 1. DESARROLLO, RENDIMIENTO Y CONSUMO DE AGUA EN CALABACITA BAJO CONDICIONES DE INVERNADERO. Celina Maeda M.
La utiliz ción de técnicas optativas para incorporar a la producción agrícola el uso de recursos como la plasticultura en invernaderos, han mostrado pers - pectivas alentadoras, por la alta producción por unidad de superficie, ahorro de agua, control de temperatura, iluminación, etc. Investigaciones del PRONAPA.

15:45 a 16:00 2. EFECTO DEL ACOLCHADO CON PELICULA PLASTICA SOBRE LA EFICIENCIA DEL USO DEL AGUA Y EL DESARROLLO DE LA PLANTA EN EL CULTIVO DE MELON. Josefina Martínez S.
Estrategia que permite eficientar el uso del agua en la producción de cultivos de importancia económica, en zonas de fuerte abatimiento de los acuíferos de la Comarca Lagunera. Se dá un programa de riego usado para el melón por transplan- te con y sin acolchado y se evalúa el comportamiento de la planta.

16:00 a 16:15 3. PLASTICULTURA: DE LA MATERIA PRIMA A LA PELICULA. Galo Carretero L.
Semblanza de los problemas a los que se enfrenta el transformador de materia - prima a producto terminado, en este caso: Peliculas de PE y PVC, de uso en - - Plasticultura. Se muestran transparencias de algunas fallas de calidad encon - tradas en algunos invernaderos de la República.

16:15 a 16:30 4. LA MATERIA PRIMA Y SU CONTROL DE CALIDAD. PVC. Humberto Goyri
Se citan características y propiedades límite para resinas base a compuestos rí gidos y plastificados de PVC, para tuberías y películas agroplásticas.

16:30 a 16:45 5. INVERNADERO TIPO TUNEL MODIFICADO, CON CUBIERTA DE POLIETILENO. E.Roberto Peralta
Los invernaderos crean microhabitats controlados para cultivos de interés agrono mico. Se muestran los diferentes tipos de estructuras y formas para los inver- naderos y se enfatiza el tipo que presente las mejores cualidades para ser utili zado en el campo mexicano.

16:45 a 17:00 6. EL SISTEMA DE MICROTUNEL DE PLASTICO Y SU INFLUENCIA SOBRE LA PRECOCIDAD, EL REN DIMIENTO, LA CALIDAD DEL FRUTO Y LA INCIDENCIA DE ENFERMEDADES EN EL CULTIVO DEL MELON . Manuel Astorga C.
El Microtúnel protege a la planta durante sus primeras fases vegetativas, crean do un microclima que influye en la precocidad, calidad y rendimiento del fruto y en una menor incidencia de enfermedades. Se sembraron 10 Ha. de melón, obte - niéndose un rendimiento promedio de 50 T./Ha.

17:00 a 17:15 DESCANSO PARA CAFE.

III CONGRESO NACIONAL DE PLASTICOS PARA LA AGRICULTURA

PROGRAMA TECNICO:

COMITE MEXICANO DE PLASTICOS EN LA AGRICULTURA, A. C.

Jueves 29 de Noviembre de 1984.

17:15 a 17:30 7. RIEGO CON ELEMENTOS PLASTICOS. Amos Tichauer.
El regar con dispositivos plásticos evita el desperdicio del aniegue, la salinización de los suelos y el uso inadecuado de mantos freáticos, racionalizando el empleo de agua y nutrientes y haciendo posible controlar el grado de humedad de acuerdo a las condiciones de los suelos y a la estadía fisiológica de las plantas bajo cultivo. Equipos modernos para horticultura.

17:30 a 18:00 8. NUEVOS SISTEMAS DE FINANCIAMIENTO PARA CULTIVOS CON AGROPLASTICOS.
Mario Novelo - FIRA, Lisandro Fernández y [illegible]onel Garza - BANPAIS.
Se presentan modalidades recientes de la [illegible]ca Oficial para financiar cultivos, haciendo hincapié en los que empleen sistemas basados en agroplásticos.

18:00 a 18:15 9. EVALUACION DE PELICULAS PLASTICAS. Eduardo Ramírez V., Marco A. Uresti H.
Importancia sobre la selección de productos de buena calidad entre los que se ofrecen en el mercado, buscando establecer las propiedades mínimas aceptables del producto, como base a futuras Normas de Calidad.

18:15 a 18:30 10. TRANSFORMACION Y CONTROL PeBD PARA USO AGRICOLA. S. Sánchez López.
Influencia de las variables de extrusión y las propiedades finales de la película. Se analizan las variables más importantes y su efecto en las propiedades de la película, así como posibles soluciones en el caso de defectos en el producto terminado.

18:30 a 18:45 11. DISEÑO DE PELICULA AGRICOLA, AVANCES EN EL ANALISIS DE LAS RELACIONES: ESPESOR, DURACION, COSTO. Virgilio A. González, Guillermo Lozano G.
Estudio de la dependencia del tiempo de transformación del PeBD sin aditivos, en película por extrusión-soplado, como función del espesor y la relación de deformación, así como la de la deformación de la estabilidad al intemperizarse las películas.

18:45 a 19:00 12. SELECCION Y CONTROL DE CALIDAD DE RESINAS PARA USO AGRICOLA. S. Montes.
Se analizan las propiedades de las películas para aplicaciones en invernaderos, acolchados, recubrimiento de canales, ollas de agua, etc., en función de las características fundamentales de la resina. Se compara la calidad entre películas nacionales y extranjeras y se revisan aspectos principales de Control de Calidad.

19:00 a 19:15 13. SITUACION, REQUISITOS Y EXPERIENCIAS DE ACOLCHADO DE SUELOS CON PELICULAS PLASTICAS. José Hernández D.
A nivel mundial el acolchado de suelos ocupa un lugar muy importante en la producción de hortalizas en los países industrializados. El acolchado ha sido lar-

PROGRAMA TECNICO

COMITE MEXICANO DE PLASTICOS EN LA AGRICULTURA, A. C.

Jueves 29 de Noviembre de 1984.

gamente investigado en estos países y requiere de películas con ciertas características que permitan su colocación mecánica. En México a través del PUDPA, PEMEX-CIQA, se tienen módulos experimentales, con resultados prometedores, en el cultivo de sandía y tomate.

19:15 a 19:30 14. CONSERVACION DE TOMATES EMBOLSADOS EN PELICULA DE POLIETILENO. René Peralta, Silvia H. Uribe Z., Ma. del Rosario Garza B., Juan H. Saucedo M., Andrés Rumayor Tomates cultivados exprofeso fueron sometidos a diferentes tratamientos, variando cuatro factores: 1.- Espesor de la película utilizada en el empaque. 2.- Temperatura de almacenamiento, 3.- Azufre del fungicida (tio),4.- Concentración del fungicida, observándose : cambio de color, firmeza y vida útil.

19:30 a 19:45 15. USO DE LOS PLASTICOS PARA SEMIFORZADO DE CULTIVOS AGRICOLAS. Marco A. Uresti. El Centro de Investigación en Química Aplicada: CIQA, tiene un proyecto para el uso de elementos plásticos para semiforzado de cultivos, cuyo objetivo es crear alternativas en la solución de producir alimentos, incrementando a la vez el eficiente uso del agua por la planta.

S.A.R.H. I.N.I.A . C.I.A.P.A.N

(ITEM 2)

A R R O P A D O

BENEFICIOS QUE NOS OFRECE :

- Control de crecimiento de malas hierbas
- Conserva la humedad del suelo
- Regula o modifica la temperatura del suelo
- Previene la costrosidad
- Mantiene la estructura y fertilidad del suelo
- Reduce o previene la erusión
- Elimina los daños en la raíz causados por los cultivos
- Reduce ciertas enfermedades
- Da una cosecha más limpia
- Modifica el medio aéreo alrededor de las plantas
- Acelera la maduración
- Mejora la producción
- Permite una cosecha más fácil

Obviamente un simple acolchado no provee de todos estos beneficios a todas las situaciones. Sino que los efectos dependen del tipo de acolchado a usar y como se aplique para cda situación.

CANTIDAD DE PLASTICO NECESARIO PARA ARROPAR UNA HECTAREA

MTS. ANCHO	KGS/HA.	ACOLCHADO
1.20	250	Surco
1.50	350	Surco
3.00	500	Canaleta
10.00	1000	Total

SARH INIA CIAPAN

TUNELES

BENEFICIOS QUE NOS OFRECEN:

- Protección al cultivo de baja temperatura y/o heladas.
- Incremento en los rendimiento por hectárea.
- Realización de siembra en etapas tempranas ó tardías con buenos resultados.
- Mayor eficiencia en el uso de agua.

MATERIAL NECESARIO PARA FORMAR TUNELES DE POLIETILENO DE 100MTS DE LONGITUD Y DISTANCIA ENTRE ARCOS DE 1.5 MTS.

ANCHO	ALTURA	KG DE ALAMBRON	CALIBRE DE PLASTICO DE 120
0.4	0.4	12	11
1.2	0.5	36	19
1.2	0.6	47	24
1.4	0.5	38	22
1.6	0.5	47	24

S.A.R.H. I.N.I.A. C.I.A.P.A.N.

I N V E R N A D E R O

EN EL VALLE DE CULIACAN HAY APROXIMADAMENTE 300 INVERNADEROS.

EN LA TEMPORADA 1984-85 SE CONSUMIERON APROXIMADAMENTE 80 TON DE POLIETILENO CALIBRE 600.

UN INVERNADERO DE 12 x 75 mts NECESITA 140 kg DE POLIETILENO.

EL COSTO PROMEDIO POR kg ES DE $ 400.00.

EN UN INVERNADERO DE 8.50 x 51 mts SE PRODUCEN 325,600 PLANTAS CADA 30 a 40 DIAS EN CHAROLA DE 200 CAVIDADES.

EL COSTO APROXIMADO DE UN INVERNADERO DE 8.50 x 51 mts COMPLETO ES DE 3.3 MILLONES DE PESOS.

(ITEM 3)

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Technical Report -- Visit to Agrotileno, Guadalajara

Gloucester 6" machine, serial 266-25284-01, Dec 1980
Center-fed 60" die, non-rotating, 50-HP blower on air ring, single orifice, air exit parallel to extrudate

Calculation of maximum screw rpm:
Motor max speed 1750 rpm (on nameplate)
Gear ratio: 17.27 (stamped into gearbox housing)
Top screw speed -- 1750/17.27 = 101.3 rpm

Production rates:
Obtained by timing and weighing rolls, allowing for weights of core and packing materials

Time	RPM	Amps	HP	Head psi	Film Width	Ft/min	Output Kg/hr	Per " Kg	Per " Lb	Blow Ratio
MonAM	73.6	350	170.4	2300	6m	--	---			1.27
MonPM	80	366	193.7	2650	6m	33	479	2.54	5.6	1.27
MonPM	80	370	195.8	2750	6m	--	496	2.63	5.8	1.27
TueAM	88.6	372	218.1	3050	10m	29.1	547	2.9	6.4	2.1
TuePM	89	394	232	3150	10m	--	---	--	-	2.1

Comments

1. Screw speed is 80-90% of maximum now, and amps are well below the 478 maximum on motor plate.

2. Pressure also well below usual safety limits (7500-10,000 psi). It rose from 2300 to 3100 in 33 hours, mostly because of rise in screw speed from 74 to 89 rpm. Screen contamination also added some pressure. Screens should be changed at least once a week -- more often at highest speed and lower melt temperature, where more pressure may be a problem.

3. HP also well below maximum of 300.

4. Feet/min digital gauge is wrong, these are measured values.

5. Output may get to 600 Kg at top speed, especially with new screens. This would give around 7 lb/hr per inch circumference, which would be as much as I would hope to cool without added devices (refrigerated air, dual air openings, internal bubble cooling).

6. Melt temperature is the missing data point. There is a gauge, but it reads well below what is expected, and must be calibrated before it can be put to use.

7. Blow ratio of 1.27 is low, may be making "splitty" film. Tensile

or tear tests will show this. The 2.1 ratio is more reasonable, but it would be a good idea to run tests on both (6m and 10m).

Making 12m x 8mil film

Right now this can't be done. Running 12m at 6 mils was tried, but the bubble broke. It was somewhat uneven (hotter on side that broke). Running the entire line cooler may help, but get confirmation via CIQA melt extensibility tests before trial. Check also if die gap is larger on far side (away from die, which is where break was). Larger gap will promote such break. Check also uniformity of air flow if possible (any leaks in hoses, blocked channels, etc.). In any case, 8-mil should be less likely to break than 6-mil.

However, we are told that at current top rates of 550-600 Kg/hr, the rate of upward pull is too slow to keep the bubble from collapsing into the die. This is reasonable, although we did not see it happen. The linear speed of the fully blown film at 600 Kg/hr would be only 12.4 ft/min - 3.8 m/min, and the speed at the die exit is much less.

There are several ways around this:

A. Pump material through the system faster, so it moves upward faster. This can be done by:

1. Better "bite" -- the amount taken in per rpm. The bite depends on rear barrel temperature, so raising this one zone to perhaps 500 F or even more might help. I will be able to predict this better if and when I get screw dimension data from Gloucester.

2. Force-feed the system with a vertical screw or other positive feeder in the hopper.

3. Preheat the feed. This also takes some load off the motor, which would be necessary if we got enough increase to bring us too close to ampere/HP limits. Preheaters blow hot air upward through the material in the hopper. They are standard industry accessories, but one can probably be locally designed and built if needed. Preheating is also used for black compounds, as the carbon black absorbs moisture and that results in a very rough surface and weak film.

4. Change screw dimensions, either by deepening the feed zone, or by making a new screw. This is the least practical of the choices, because of the huge size of the screw and the costs involved.

B. Run so that the plastic is cooler as it comes out of the die. Thus it has more melt strength and is less likely to sag or blow out. This may be possible by cooling the barrel, especially the two front zones and the bottom of the die. The die lips should be left hot to keep the pressure down, as this is where most of the pressure demand is created. There are devices which can be placed between the changer and the die which both mix and cool, but I would not try this until most other ideas have not worked out.

C. Better cooling of the plastic as it comes out of the die, so it gets strong more quickly and doesn't sag. This is harder than it sounds. It is not a matter of more air (we have plenty of excess blower capacity), but it requires the air to be more efficiently applied in the first 10-20 cm after the plastic leaves the die. A second air ring, or better bubble stabilization, won't help here. I will be talking to Sano and perhaps others on this matter, and if they sound encouraging -- that is, if they can suggest and offer an air ring change that is promising, I will report this to you. This will be a costly alternative -- even if just an insert is needed, I would expect it to cost at least $10,000 in the USA and probably more, and (unlike the preheater) it can't easily be made by people who haven't done them before and are not used to the precision machining required.

D. All this has assumed the same material, Pemex 04. When we consider material change, then a whole new group of options are possible: blends with low-melt-index high-density PE, to give more melt strength ... adding a minor amount of another polyolefin, such as polybutylene ... even adding a little cross-linking agent that reacts at extrusion temperatures, to give the appropriate strength. Such formulation work would be best done at CIQA or Pemex or both. It sounds unusual to those used to polyethylenes, but it is done with PVC all the time.

If it happens that the only way to get 12m x 8mil film without great expense is to run at conditions at the limit of the machine, keep in mind that the machine will not be running at these conditions all the time, every day, all year. There isn't enough market to support that. Thus, we are talking about occasional running at limits, not constant stress on the system. If Gloucester says their machine can run steadily at 300 HP and 5000 psi or more, and we can do so without excessive leaks, why not run that way? I will try to extract from them an idea of the safety factor they build into their equipment, as well as information on what protective devices are there (motor fuses, rupture discs, safety bolts, etc.).

Additional Technical Comments

SCRAP RE-USE. This is essential for competitive economics. Film that is the wrong dimension, or trim, or clean start-up material, must be recovered such as to gain full value again from it. If this isn't done, the added costs might make the products too expensive for many buyers. There is a vast body of technology grown up around scrap film recovery over the last ten years; I have already provided copies of technical articles and can supply more details as needed.

WRINKLES. These seem to come at the point where the film turns upward again, underneath the first platform. Their removal isn't essential for agricultural uses, but the film would look much better, and convey a

more reliable and valuable image. We have already discussed the ways to remcve the wrinkles, and the easiest -- a spiral tape around th appropriate ıoll -- should be tried. Caution: the tape must stick firm ly, or else it will be pulled away by the film. Use a tape whose adhesive can be removed by a solvent -- makes cleaning the roll easier when tape is to be re-applied.

FEEDING. Manual feeding by opening bags over the hopper runs the risk of an empty hopper, adds contamination from bag fibers and dirt on bag surfaces, and is not easy to do at 600 Kg/hr or more - one bag almost every two minutes. Plant management is aware of this problem, and told us that a large enough feeder was to come soon. Feeding such a large machine from bags is unusual, unless the plastic is not available in larger containers such as 500-Kg cartons, truckloads and railcars (feeding a silo); sometimes the plastic is less expensive this way.

TEMPERATURE CONTROLS. We noticed the controllers varying across a band of as much as 30ºF. This may be the best they can do, or perhaps they are tuned wrongly (tuning is the setting of constants inside the contro instruments). This swing of barrel temperature will show in some thick ness variation (surge) in the product. We measured this variation for a short time, and found it not very high, but it could be better, and any tightening of tolerances means material saved, as aim thickness can be lowered. If the performance of the controllers can't be improved, it might be advisable to turn them off , at least in zones 3 and 4, after start-up; the material will not cool down (turn the coolers off, too), as enough heat will be generated by the friction of the screw turning in the barrel -- that is where most of the heat comes from, anyway (motor HP consumed is much more than heater power).

ALG:December 6, 1984