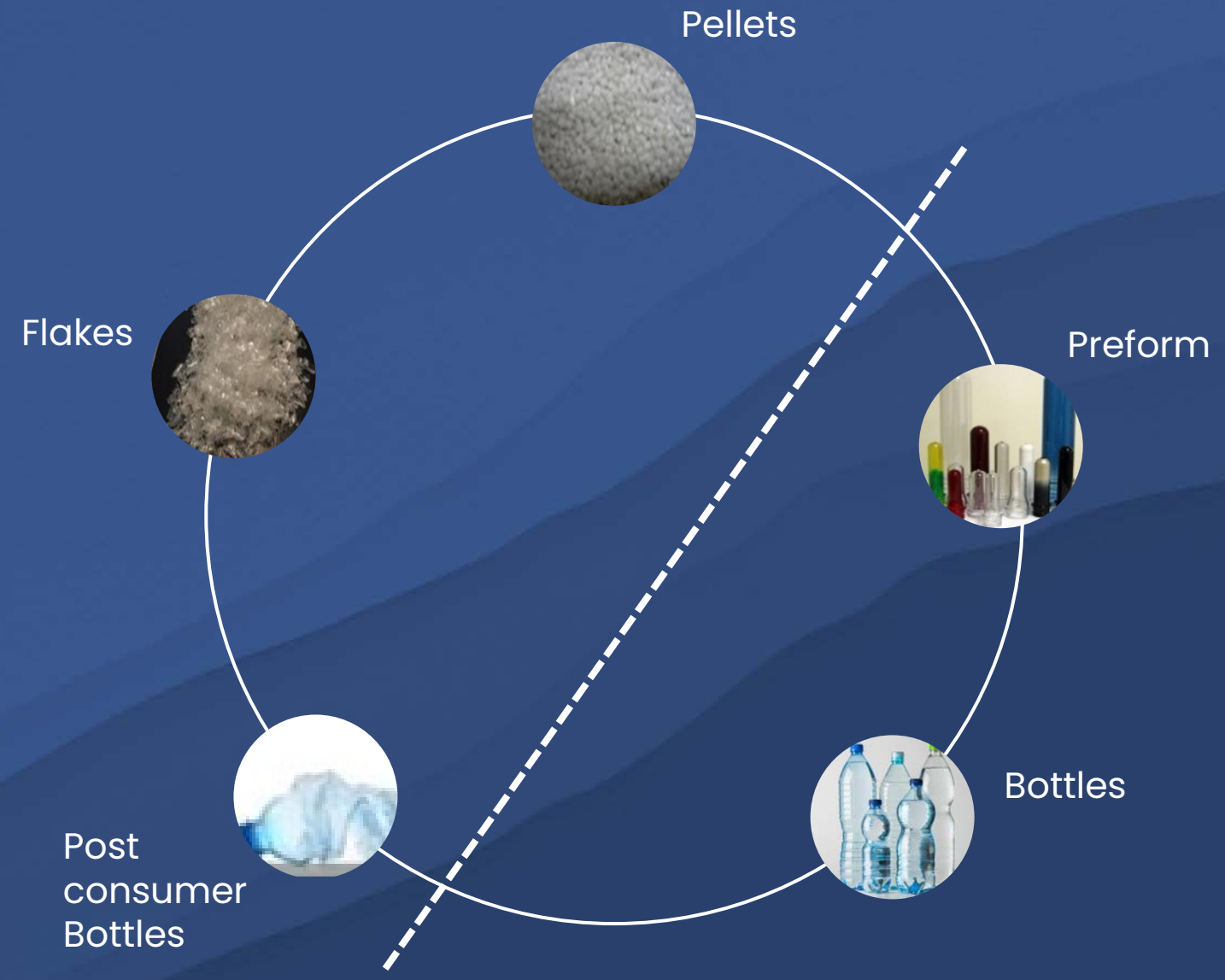




BARIQ TECHNICAL PRESENTATION



Bottle To Bottle Process - Flow Chart



Bottle To Bottle Process – Description of the process

The recycling processes BariQ produce recycled PET pellets from PET containers, coming from post-consumer collection systems (curbside and deposit collection systems). The recycling processes are composed of the four steps below:

Input • In Step 1, post-consumer PET containers are processed into hot caustic washed and dried flakes which are used as input of the processes.

Decontamination and production of recycled PET material •

In Step 2, the flakes are dried and crystallized in a reactor under inert gas or desiccant air flow at high temperature. •

In Step 3, flakes are extruded under vacuum at high temperature and then crystallized. •

In Step 4, crystallized pellets are pre-heated before being handled over in a continuous running solid state polymerization reactor at high temperature and vacuum.

Description of the main steps :

Drying and crystallization (step 2): In this step the flakes are dried and crystallized at high temperature in a reactor under inert gas or desiccant air flow, in a continuous process.

Extrusion and crystallization (step 3): The flakes from the previous step are fed to an extruder under high temperature and vacuum for a predefined residence time. Further decontamination occurs in this step. The extruded pellets are then crystallized at high temperature in a further reactor under atmospheric pressure.

SSP reactor (step 4): The crystallized pellets are continuously pre-heated in a reactor before being introduced in the solid state polymerization reactor running under vacuum for a predefined high temperature and residence time.

Bottle To Bottle Process – Description of the process

TECHNICAL DATA OF THE WASHED FLAKES AS PROVIDED BY EFSA

Washed and dried flakes used for the BariO recycling process

Parameter	Value
Moisture max.	1.0%
Moisture variation	$\pm 0.3\% \text{ h}^{-1}$
Bulk density	300 kg m^{-3}
Bulk density variation	$\pm 100 \text{ kg m}^{-3} \text{ h}^{-1}$
Material temperature	10 – 60 °C
PVC max.	20 ppm
Glue max.	50 ppm
Polyolefins max.	50 ppm
Cellulose (paper, wood)	50 ppm
Metals max.	50 ppm
Polyamide max.	50 ppm

Bottle To Bottle Process – Description of the process

Pellets manufacturing stage:

- The flakes are shipped to the processing line after their quality is approved in the laboratory to the processing line.
- The material is shipped into silos to verify its uniformity.
- Then the first drying (removal of moisture and oils from the surface of the peels) is carried out through the HAD at a temperature ranging from 150 to 170 degrees using hot air, which is re-purified to remove the oils through condensers.
- Then secondary drying (complete removal of moisture and oils from inside the peel particles) through the PDU at a temperature ranging from 170 to 190 degrees using hot air, which is re-purified to remove the oils through condensers.
- The raw material is transferred to the extruder to transform it into a liquid state and remove volatile gases, pollutants and oil vapors through a degassing pump.
- The molten material is crushed after removing small particles other than PET and metals using ultra-fine filters (50 microns). Then the material is transferred to the crystallization process through the PCU silo
- Finally, the raw material is transferred to the SSP stage by transferring it to the reactor in order to withdraw and remove all gases using a vacuum pump for a period of no less than 6 hours under a pressure of no more than 10 mbar.
- After the material has remained for a period of no less than 6 hours, it is transferred to the cooling unit and then packed into containers. The weighing capacity is 1200 kg.

Bottle To Bottle Process – Description of the process

Efficiency of the decontamination of the three steps of the Starlinger:

Table 1: Efficiency of the decontamination of the three steps of the Starlinger IV+® technology

Surrogates	Concentration before drying and crystallisation (step 2) (mg/kg PET)	Concentration after SSP (step 4) (mg/kg PET)	Decontamination Efficiency (%)
Toluene	563	<0.8*	>99.9
Chloroform	1900	<0.5*	>99.9
Phenylcyclohexane	538	<0.3*	>99.9
Benzophenone	694	10.8	98.4
Lindane	373	33.9	90.9

* Not detected at the limits of detection of 0.8 mg/kg PET, 0.5 mg/kg PET and 0.3 mg/kg PET respectively

Upgrading Line Process Flow Chart

Feeding screw

Mixing Silo

Hot Air-Drying Unit

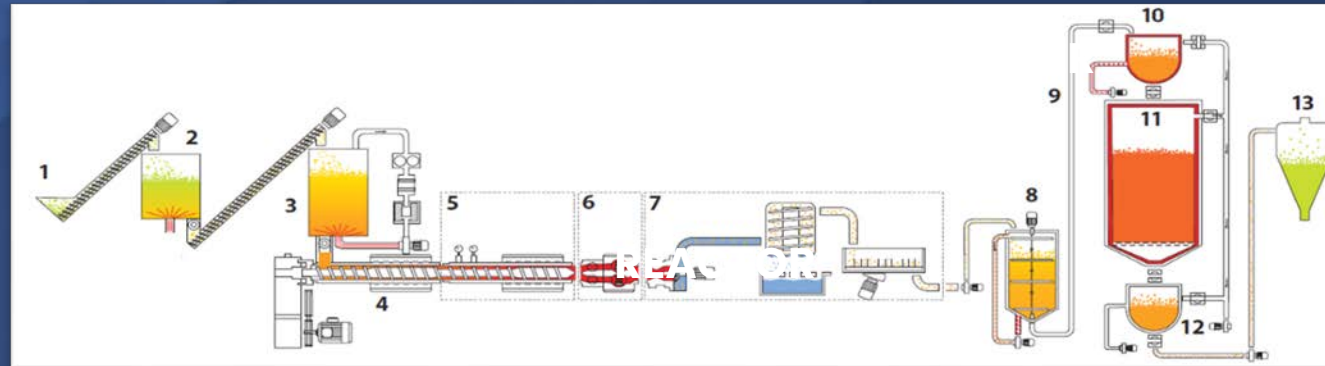
Pre-Drying Unit

Extruder

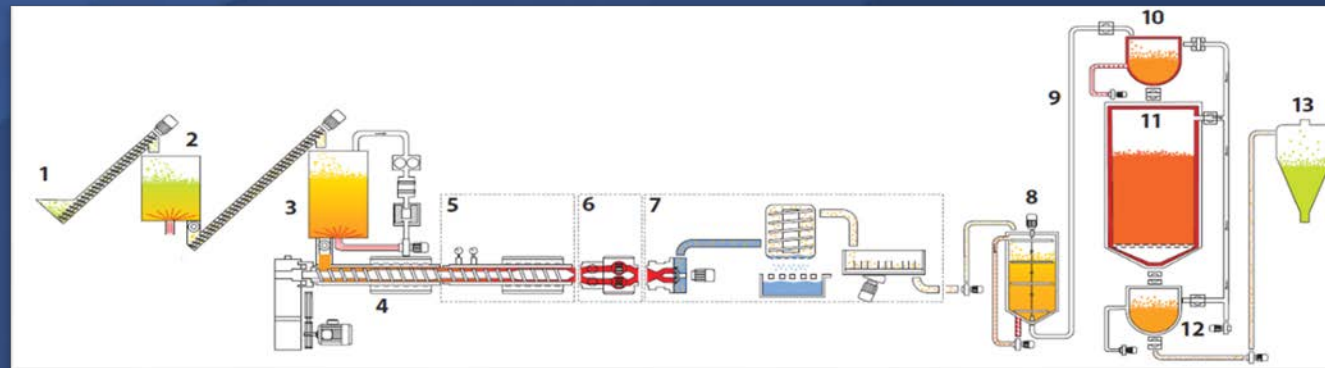
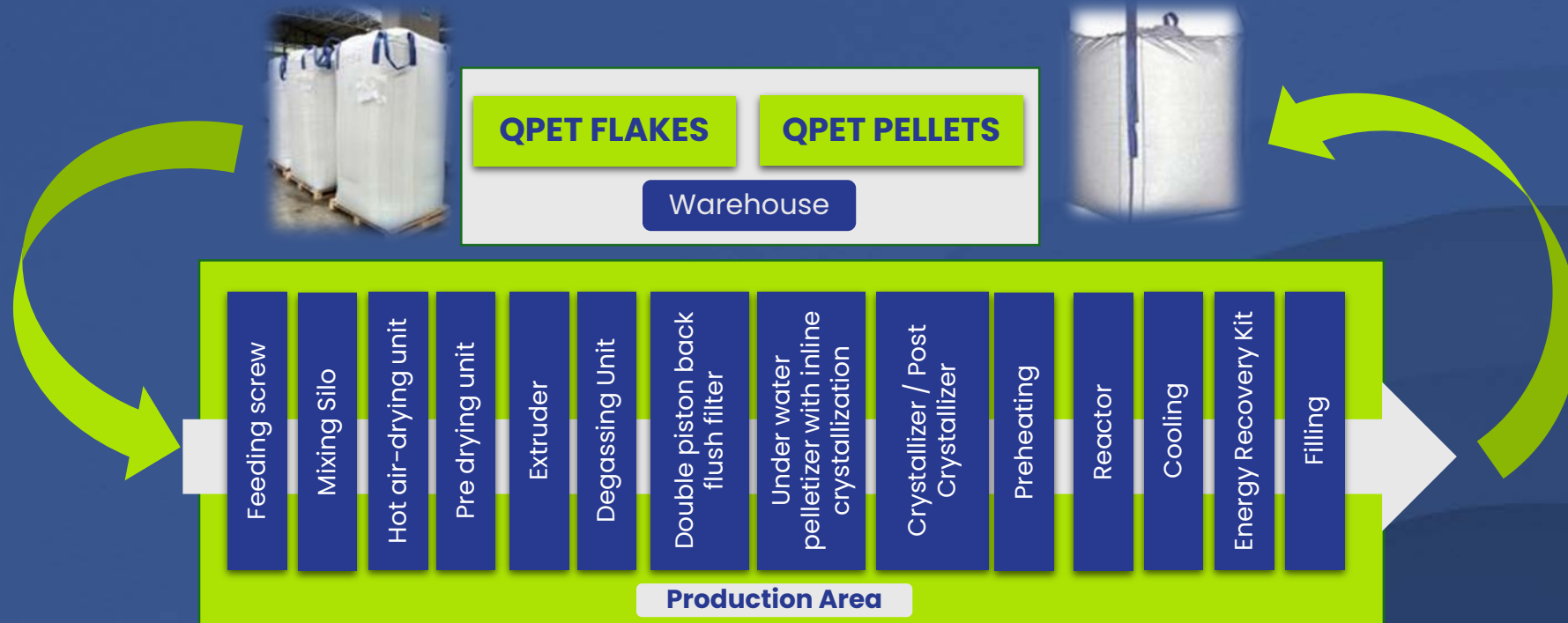
Degassing Unit

Double Piston Back Flush Filter

**UNDER WATER PELLETIZER WITH INLINE
CRYSTALLIZATION**



Upgrading Line Process Flow Chart



01. START UP

It is the **first step** for the operations.

It takes **2.5 ~ 4 hours** for start up of the heaters ,
excluding the material retention time of material in:

- **HAD** (60 mins)
- **PDU** (1~ 1.5 hours)
- **PCU** (40 mins)
- **RE** (min. 6 hours)

Total start up is 11.5 ~ 13.5 hours.

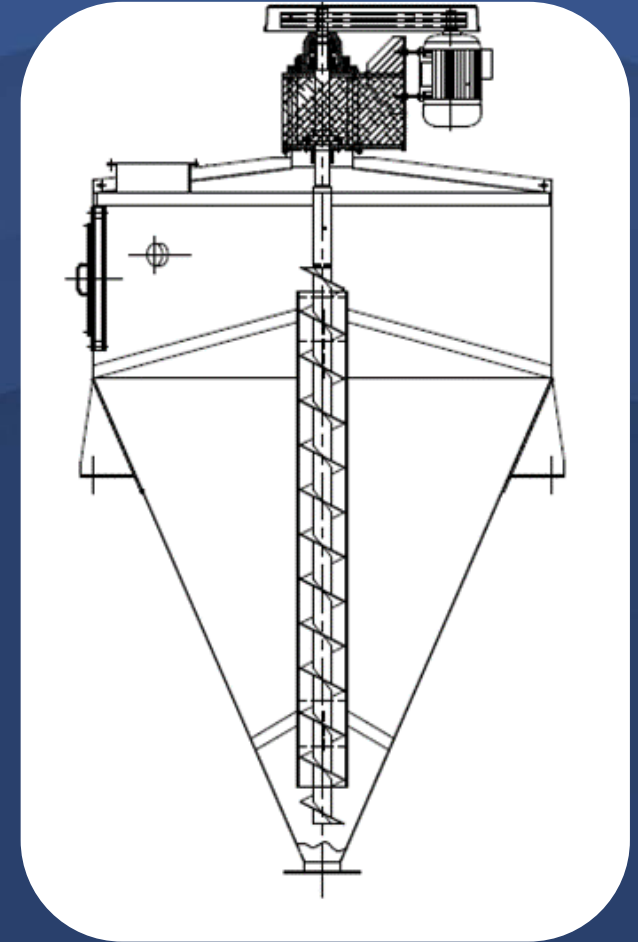
FDA & EFSA approved machinery to produce **Food
Grade Pellets**



02. MIXING SILO

Its function : is to **intermix** the flakes to make it homogenous for further processing

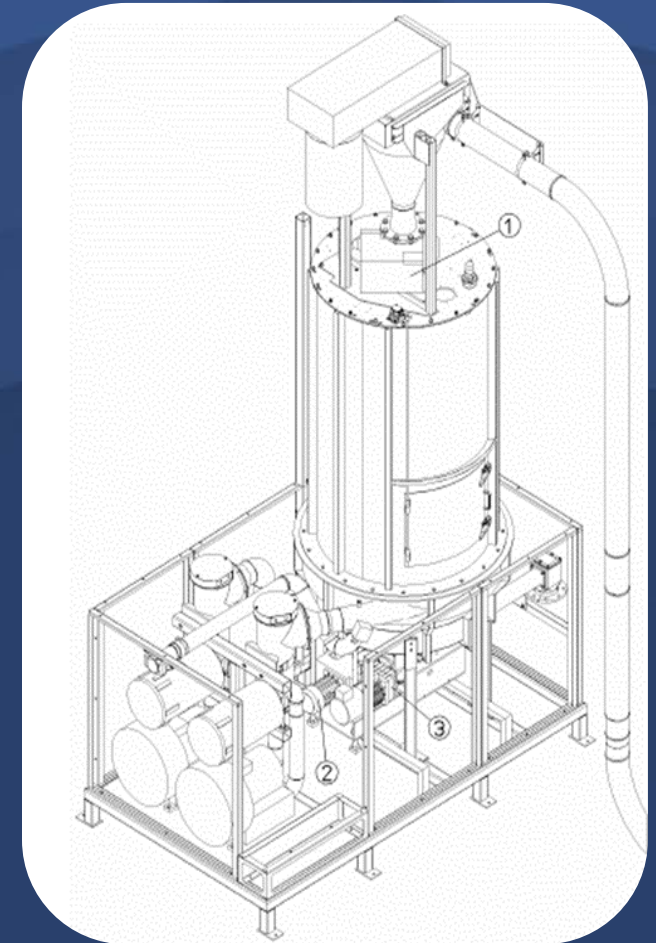
Accounted as : Critical point (**CP**) for **IV** **homogeneity** of **[Quality of Product]**



03. HOT AIR-DRYING UNIT

It is the second stage of upgrading line and contains the following units (from starting of sequence):

- **Material charge:**
The material is taken over by a screw conveyor into the drying pot
- **Drying pot:**
In the drying pot, the material is brought to a desired temperature.
- **Metal separator:**
Metal parts found in the material are identified and precipitated
- **Agitator:**
It insures the complete and uniform mixing of heated materials.
Thereby, uniform transformation of the material structure is ensured.



03. HOT AIR-DRYING UNIT

Air heating:

Air is heated and led into the drying pot from the ERK

Dust filter:

Filters the dust particulates from the heated air.

Discharge screw conveyor:

The crystallized material is conveyed with a worm screw.

Metal detector unit is the **main** unit in this stage.

Its function : is to **initial heating** the flakes & **separate** metal particles

Accounted as : Critical point (**CP**) for **IV** of pellets [**Quality of Product**]



04. PRE-DRYING UNIT

It is the third stage of upgrading line and contains the following units
(from starting of sequence):

Pre-drying tank:

The material is dried in the pre-drying tanks at the desired temperature.

Agitators:

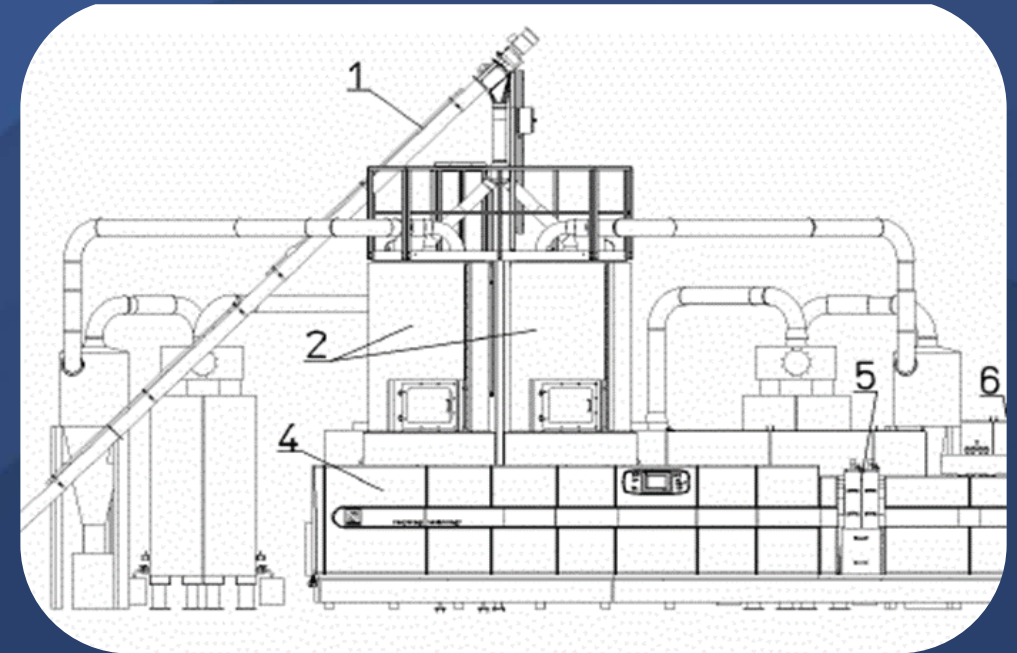
The agitators assure a constant discharge of the dried material into the openings of the extruder feed screws.

Extruder feed:

The material is fed directly into the extruder's infeed zone by two screw conveyors.

Air dryer:

Allows the material to be heated up by dry air in the pre-drying tanks.



04. PRE-DRYING UNIT

Air filters:

Filter the exhaust air from the predrying tank.

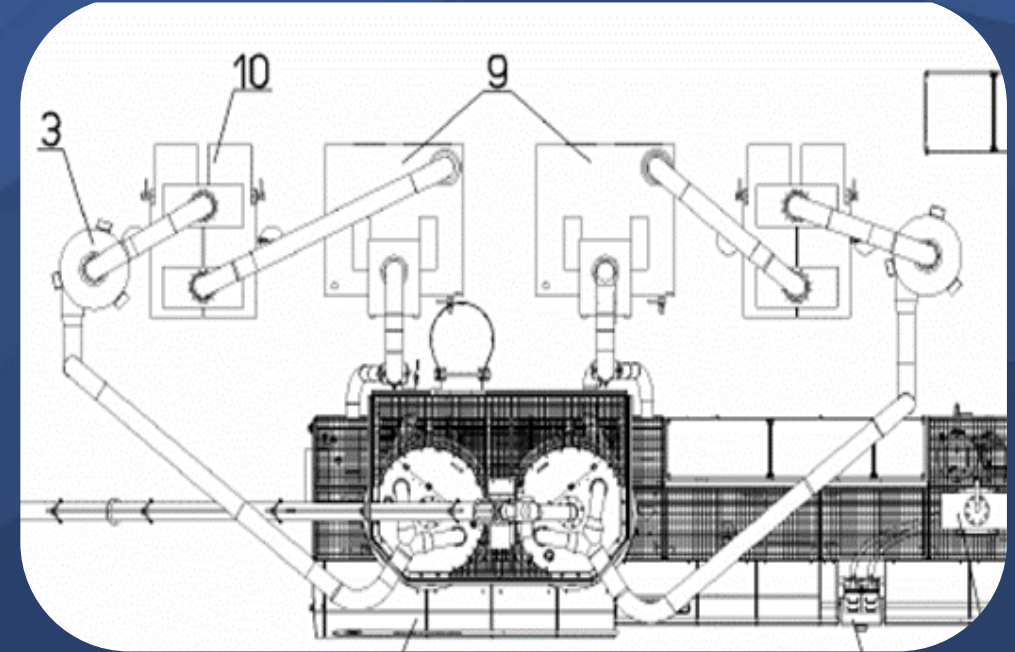
Condensate separator:

Allows separation of adhesive and lubricant residues exhausted from predrying tank to protect the air dryer.

Driers units are the **main** unit in this stage.

Its function : is to **remove the moisture** from the flakes by driers & **chemical & organic residuals** by condensers

Accounted as : Critical point (**CCP**) for **IV** of pellets [**Quality of Product**]
Critical point (**CCP**) for **Color** of pellets [**Quality of Product**]



05. EXTRUDER

It is the **fourth** stage of upgrading line.

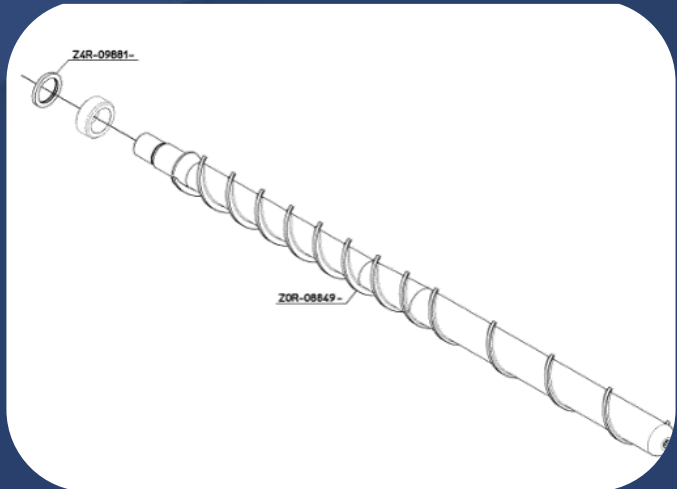
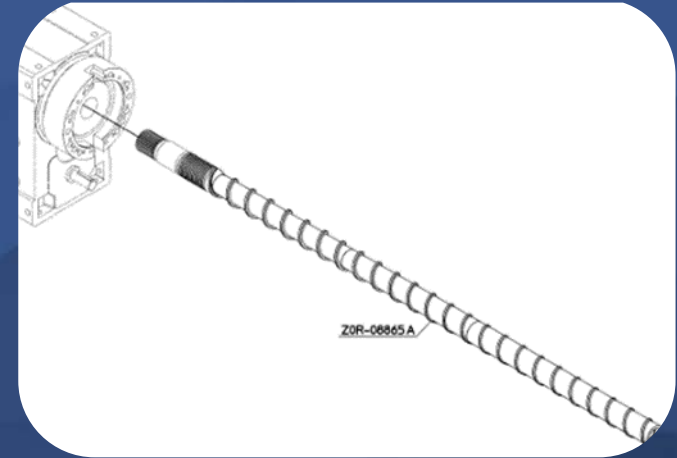
Extruder unit is one of the **main** units in this line

It consists of **two single screws** connected together.

- First one to **transform** the flakes to **molten PET**
- Second one to **build the chains** of PET (**IV**)

Its function : is to **transform** the flakes to **molten PET** and **essential** step to control **IV** and **AA**

Accounted as : Critical control point (**CCP**) for **IV** of pellets [**Quality of Product**]





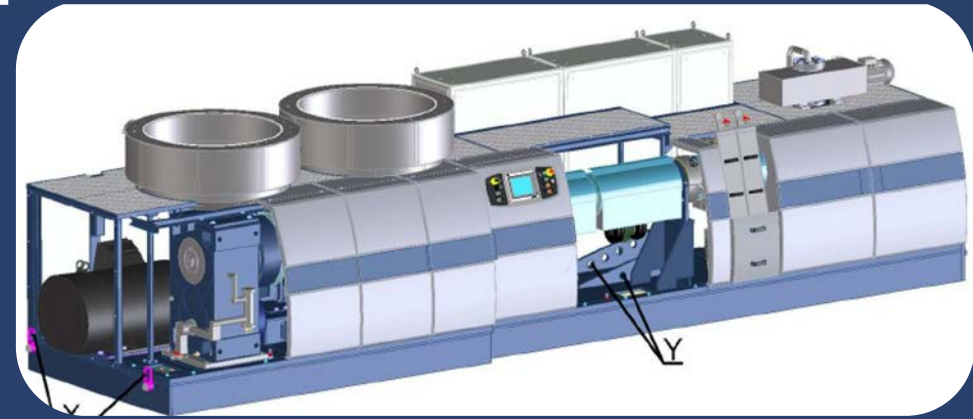
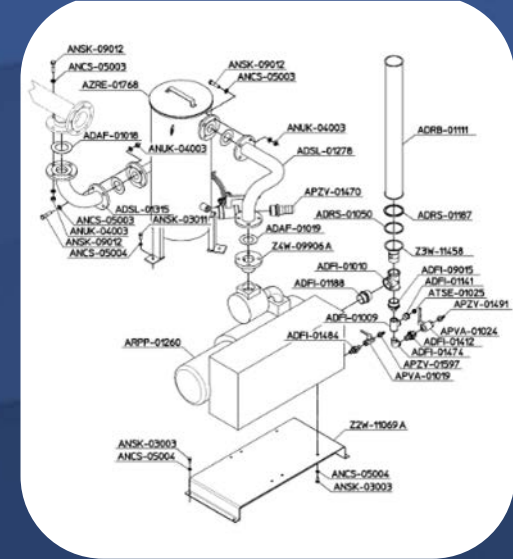
06. DEGASSING UNIT

It is a **stage** in **fourth** stage of upgrading line.

A vacuum pump is installed to **suck** contamination.
Assemble exhaust air duct and connect to exhaust pipe at cyclone.

Its function : is to **eliminate** VOC contamination from
the **molten PET**

Accounted as : Critical control point (**CCP**) for **IV** of pellets [**Quality of Product**]
Critical control point (**CCP**) for **AA** of pellets [**Quality of Product**]





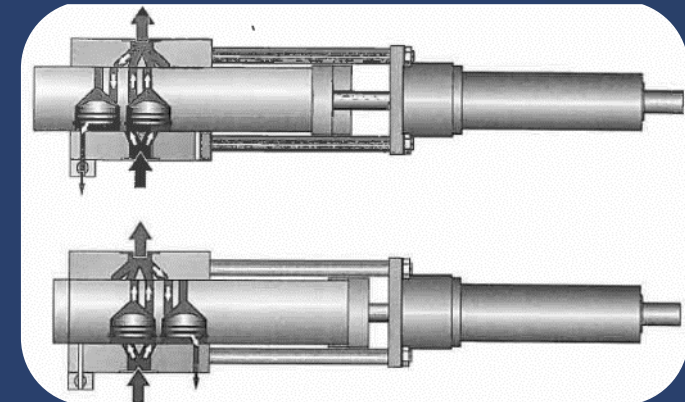
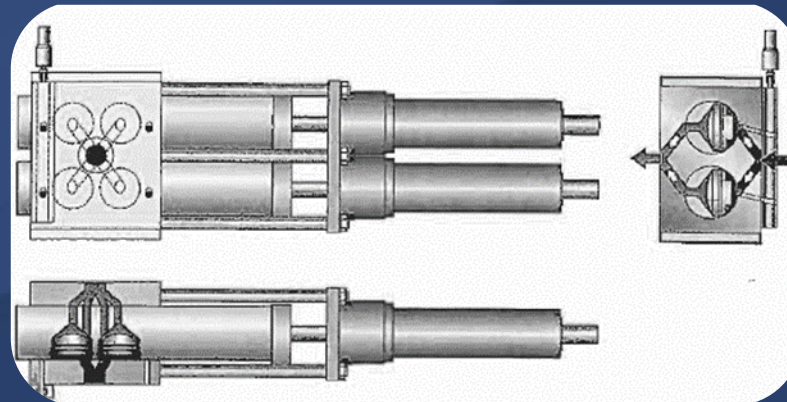
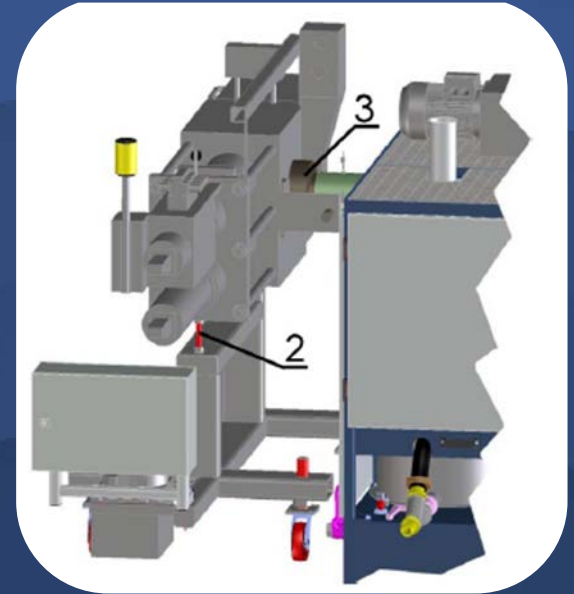
07. DOUBLE PISTON BACK FLUSH FILTER

It is a **stage** in **fourth** stage of upgrading line.

Screen holder unit is the **main** unit in this stage.

Its function : is to **dispose** the solid contamination through the **molten PET** flow

Accounted as : Critical point (CP) for **IV** of pellets
[Quality of Product]



08. UNDER WATER PELLETIZER WITH INLINE CRYSTALLIZATION

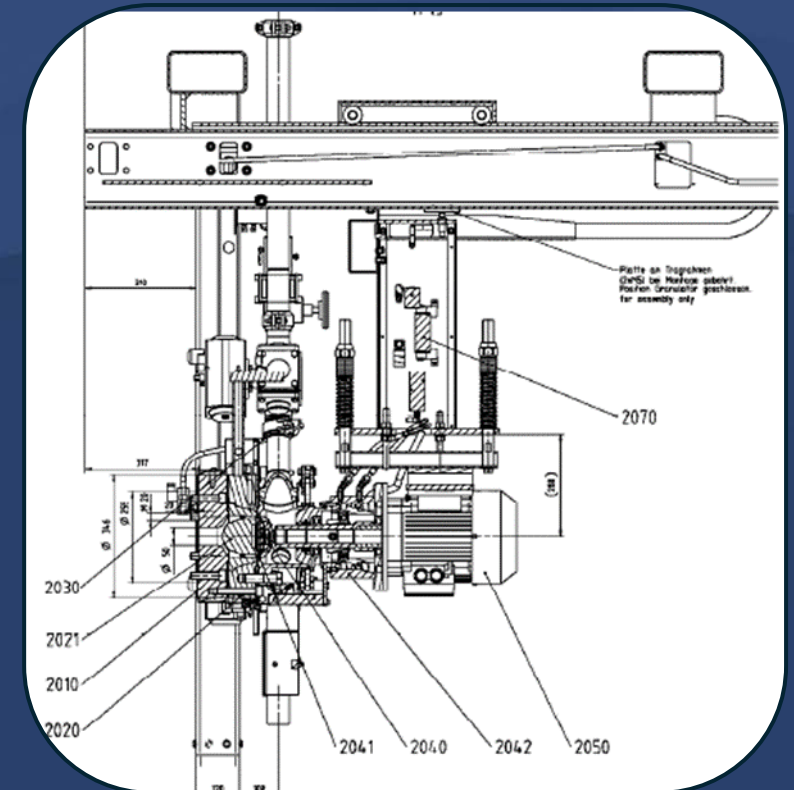
It is the **fifth** stage of upgrading line.

it had been upgraded from to **60 PZ**

Pelletizer motor unit is the **main** unit in this stage.

Its function : is to **cut** the molten PET flow to **pellets**
and to transferred it by **water**

Accounted as : Critical control point (**CCP**) for **VOC**
contamination cost of pellets [**Quality of Product**]



09. CRYSTALLIZER / POST CRYSTALLIZER

It is the **sixth** stage of upgrading line.

PCU unit is the **main** unit in this stage.

Its function : is to **complete** the crystallization of the pellets

Accounted as : Critical control point (**CCP**) for **IV** of pellets [**Quality of Product**]



10. PREHEATING

It is the **first** part of **final** stage of upgrading line

Preheaters units are the **main** units

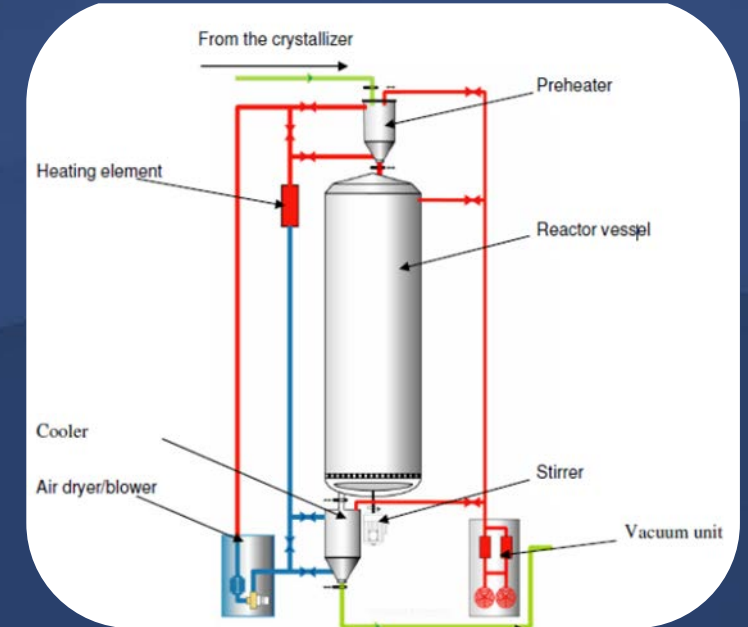
Material drop temperature **must not** be lower than **190 ° C**
Conveying system is done by **vacuum**

Its function : is to **prepare** the pellets for **upgrading IV** of pellets

Accounted as : Critical control point (**CCP**) for **IV** of pellets
[**Quality of Product**]

Critical control point (**CCP**) for
decontamination of pellets [**Quality of Product**]

Critical control point (**CCP**) for **productivity**
of pellets [**Production Performance**]



11. REACTOR

It is the **second** part of **final** stage of upgrading line

Vessel unit is the **main** unit

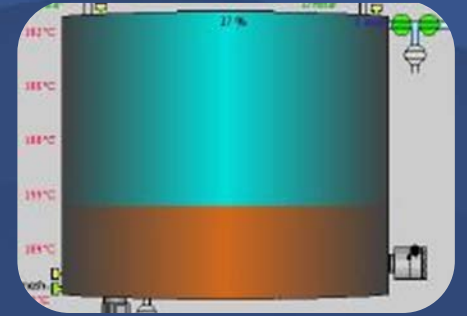
Retention time **mustnot** be lower than **6 hr** under **10mbar Vacuum**

Its function : is to **increase** the IV of pellets

Accounted as : Critical control point (**CCP**) for **IV** of pellets
[**Quality of Product**]

Critical control point (**CCP**) for **decontamination** of
pellets [**Quality of Product**]

Critical control point (**CCP**) for **productivity** of
pellets [**Production Performance**]





**EFSA / NFSA
FOOD SIMULANTS**

EFSA FOOD SIMULANTS

ANNEX III

Food simulants

1. Food simulants

For demonstration of compliance for plastic materials and articles not yet in contact with food the food simulants listed in Table 1 below are assigned.

Table 1

List of food simulants

Food simulant	Abbreviation
Ethanol 10 % (v/v)	Food simulant A
Acetic acid 3 % (w/v)	Food simulant B
Ethanol 20 % (v/v)	Food simulant C
Ethanol 50 % (v/v)	Food simulant D1
Vegetable oil (*)	Food simulant D2
poly(2,6-diphenyl-p-phenylene oxide), particle size 60-80 mesh, pore size 200 nm	Food simulant E

(*) This may be any vegetable oil with a fatty acid distribution of

No of carbon atoms in fatty acid chain: No of unsaturation	6-12	14	16	18:0	18:1	18:2	18:3
Range of fatty acid composition expressed % (w/w) of methyl esters by Gas chromatography	< 1	< 1	1,5-20	< 7	15-85	5-70	< 1,5

EFSA FOOD SIMULANTS

2. General assignment of food simulants to foods

Food simulants A, B and C are assigned for foods that have a hydrophilic character and are able to extract hydrophilic substances. Food simulant B shall be used for those foods which have a pH below 4.5. Food simulant C shall be used for alcoholic foods with an alcohol content of up to 20 % and those foods which contain a relevant amount of organic ingredients that render the food more lipophilic.

Food simulants D1 and D2 are assigned for foods that have a lipophilic character and are able to extract lipophilic substances. Food simulant D1 shall be used for alcoholic foods with an alcohol content of above 20 % and for oil in water emulsions. Food simulant D2 shall be used for foods which contain free fats at the surface.

Food simulant E is assigned for testing specific migration into dry foods.

3. Specific assignment of food simulants to foods for migration testing of materials and articles not yet in contact with food

For testing migration from materials and articles not yet in contact with food the food simulants that corresponds to a certain food category shall be chosen according Table 2 below.

For testing overall migration from materials and articles intended to come into contact with different food categories or a combination of food categories the food simulant assignment in point 4 is applicable.

Table 2 contains the following information:

Column 1 (Reference number): contains the reference number of the food category.

Column 2 (Description of food): contains a description of the foods covered by the food category

Column 3 (Food simulants): contains sub-columns for each of the food simulants

EFSA FOOD SIMULANTS

EN

Official Journal of the European Union

The food simulant for which a cross is contained in the respective sub-column of column 3 shall be used when testing migration of materials and articles not yet in contact with food.

For food categories where in sub-column D2 the cross is followed by an oblique stroke and a figure, the migration test result shall be divided by this figure before comparing the result with the migration limit. The figure is the correction factor referred to in point 4.2 of Annex V to this Regulation.

For food category 01.04 food simulant D2 shall be replaced by 95 % ethanol.

For food categories where in sub-column B the cross is followed by (*) the testing in food simulant B can be omitted if the food has a pH of more than 4.5.

For food categories where in sub-column D2 the cross is followed by (**) the testing in food simulant D2 can be omitted if it can be demonstrated by means of an appropriate test that there is no 'fatty contact' with the plastic food contact material.

EFSA FOOD SIMULANTS

Table 2
food category specific assignment of food simulants

(1) Reference number	(2) Description of food	(3) Food simulants					
		A	B	C	D1	D2	E
01	Beverages						
01.01	Non-alcoholic beverages or alcoholic beverages of an alcoholic strength lower than or equal to 6 % vol: A. Clear drinks: Water, ciders, clear fruit or vegetable juices of normal strength or concentrated, fruit nectars, lemonades, syrups, bitters, infusions, coffee, tea, beers, soft drinks, energy drinks and the like, flavoured water, liquid coffee extract B. cloudy drinks: juices and nectars and soft drinks containing fruit pulp, musts containing fruit pulp, liquid chocolate		X(*)	X			
01.02	Alcoholic beverages of an alcoholic strength of between 6 %vol and 20 %.			X			
01.03	Alcoholic beverages of an alcoholic strength above 20 % and all cream liquors				X		
01.04	Miscellaneous: undenaturated ethyl alcohol		X(*)			Substitute 95 % ethanol	

NFSA FOOD SIMULANTS

٢٤٦ الوقائع المصرية - العدد ٢٣٠ تابع (د) في ١٨ أكتوبر سنة ٢٠٢٢

الملحق الثالث

أولاً - القواعد العامة لطرق فحص المواد البلاستيكية الملامسة للغذاء

١-١ محاكيات الغذاء:

يتم تخصيص محاكيات الأغذية المدرجة بجدول (١-أ) لتحديد مطابقة المواد البلاستيكية الملامسة للغذاء التي لم تلامس الغذاء :

جدول (١- أ)

قائمة محاكيات الأغذية

الرمز المخصص لها	إسم محاكى الغذاء
محاكى غذائى (أ)	Ethanol 10% (v/v)
محاكى غذائى (ب)	Acetic acid 3% (w/v)
محاكى غذائى (ج)	Ethanol 20% (v/v)
محاكى غذائى (د)	Ethanol 50% (v/v)
محاكى غذائى (٢د)	Any vegetable oil containing less than 1% unsaponifiable matter
محاكى غذائى (هـ)	Poly (2,6-diphenyl-p-phenylene oxide), particle size 60-80 mesh, pore size 200nm

NFSA FOOD SIMULANTS

التحديد العام لمحاكيات الغذاء حسب نوع الغذاء:

(أ) تُخصص محاكيات الغذاء (أ ، ب ، ج) للأغذية المحبة للماء (Hydrophilic) وتستطيع استخلاص المواد المحبة للماء. يستخدم محاكى الغذاء (ب) للأغذية التى لها أس هيدروجينى (pH) أقل من ٤,٥ ، ويستخدم محاكى الغذاء (ج) للأغذية الكحولية ذات محتوى كحولى حتى (٢٠%) وكذلك الأغذية التى تحتوى على كمية من المكونات العضوية ذات الصلة التى تجعل الغذاء محب أكثر للدهون.

(ب) تُخصص محاكيات الأغذية (د ، د٢) للأغذية المحبة للدهون (Hydrophobic) وتستطيع استخلاص المواد المحبة للدهون. يستخدم المحاكى الغذائى (د) للأغذية الكحولية ذات محتوى كحولى أكثر من (٢٠%) ولمستحلبات الزيت فى الماء. ويستخدم المحاكى (د٢) للأغذية التى تحتوى على دهون حرة على السطح. يخصص المحكى الغذائى (ه) لاختبار الهجرة النوعية فى الأغذية الجففة.

NFSA FOOD SIMULANTS

١-٣ التحديد النوعى لمحاكيات الغذاء للأغذية لاختبارات الهجرة للمواد البلاستيكية الملامسة للغذاء التى لم تلامس الغذاء بعد :

(أ) يتم اختيار محاكيات الغذاء التى تقابل مجموعة غذائية معينة طبقاً للجدول (١-ب) لاختبار الهجرة من المواد البلاستيكية الملامسة للغذاء التى لم تلامس الغذاء بعد ،

(ب) لاختبار الهجرة من المواد البلاستيكية الملامسة للمجموعات الغذائية أو خليط منها والغير مذكورة فى جدول (١-ب)، يجب استخدام التحديد العام لمحاكيات الغذاء المدرج فى البند (١-٢) من الجزء (١) من نفس الملحق لاختبار الهجرة النوعية كما يتم استخدام محاكى الغذاء المدرج فى البند (١-٤) من الجزء (١) من نفس الملحق لاختبارات الهجرة الكلية.

جدول (١-ب)

التحديد النوعى لمحاكيات الغذاء للمجموعات الغذائية

- العمود ١ (الرقم المرجعى) : يحتوى على الرقم المرجعى للمجموعة الغذائية .
 - العمود ٢ (وصف الغذاء) : يحتوى على وصف للأغذية التى تشملها المجموعة الغذائية .
 - العمود ٣ (محاكى الغذاء) : يحتوى على أعمدة فرعية لكل نوع من المحاكيات الغذائية .
- يستخدم محاكى الغذاء التى توجد علامة (X) فى العمود الفرعى الخالص من العمود ٣ عند فحص الهجرة للمواد البلاستيكية الملامسة للغذاء التى لم تلامس الغذاء بعد .

NFSA FOOD SIMULANTS

١-٣ التحديد النوعى لمحاكيات الغذاء للأغذية لاختبارات الهجرة للمواد البلاستيكية الملامسة للغذاء التى لم تلامس الغذاء بعد :

(أ) يتم اختيار محاكيات الغذاء التى تقابل مجموعة غذائية معينة طبقاً للجدول (١-ب) لاختبار الهجرة من المواد البلاستيكية الملامسة للغذاء التى لم تلامس الغذاء بعد ،

(ب) لاختبار الهجرة من المواد البلاستيكية الملامسة للمجموعات الغذائية أو خليط منها والغير مذكورة فى جدول (١-ب)، يجب استخدام التحديد العام لمحاكيات الغذاء المدرج فى البند (١-٢) من الجزء (١) من نفس الملحق لاختبار الهجرة النوعية كما يتم استخدام محاكى الغذاء المدرج فى البند (١-٤) من الجزء (١) من نفس الملحق لاختبارات الهجرة الكلية.

جدول (١-ب)

التحديد النوعى لمحاكيات الغذاء للمجموعات الغذائية

- العمود ١ (الرقم المرجعى) : يحتوى على الرقم المرجعى للمجموعة الغذائية .
- العمود ٢ (وصف الغذاء) : يحتوى على وصف للأغذية التى تشملها المجموعة الغذائية .
- العمود ٣ (محاكى الغذاء) : يحتوى على أعمدة فرعية لكل نوع من المحاكيات الغذائية .
- يستخدم محاكى الغذاء التى توجد علامة (X) فى العمود الفرعى الخالص من العمود ٣ عند فحص الهجرة للمواد البلاستيكية الملامسة للغذاء التى لم تلامس الغذاء بعد .

NFSA FOOD SIMULANTS

- المجموعات الغذائية التي أحتوى العمود الفرعى (د أو هـ) علامة (X) متبوعة بشرط مائلة (/) ورقم، فيجب أن تقسم نتيجة اختبار الهجرة على هذا الرقم قبل مقارنة النتيجة مع حد الهجرة. نتيجة الاختبار المصححة هي التي تستخدم للمقارنة مع حد الهجرة لإثبات المطابقة. نتائج الاختبارات للمواد التي لا يجب أن تهاجر بكميات يمكن الكشف عنها ((Non detected (ND)) لا يتم تصحيحها بهذه الطريقة .

- يتم استبدال محاكى الغذاء (د) بكحول إيثيلي (Ethanol) (٩٥%) للمجموعة الغذائية ١-٤ فى جدول (١-ب) .

- المجموعات الغذائية التي أحتوى العمود الفرعى (ب) علامة (X) متبوعة بـ (*) فيمكن إلغاء الفحص بمحاكى الغذاء (ب) إذا كان الأس الهيدروجينى (pH) للغذاء أعلى من ٤,٥

- المجموعات الغذائية التي أحتوى العمود الفرعى (د) علامة (X) متبوعة بـ (***) فيمكن إلغاء الفحص بمحاكى الغذاء (د) إذا كان يمكن استخدام فحص ملائم لإظهار عدم وجود تلامس دهنى مع المادة البلاستيكية الملامسة للغذاء .

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جدول (١ - ب)

٣						٢	١
محاكيات الأغذية						وصف الغذاء	الرقم المرجعي
هـ	د	د	ج	ب	ا		
						المشروبات :	١
						المشروبات غير الكحولية أو المشروبات الكحولية ذات محتوى كحولي لا يزيد عن ٦٪ حجمًا .	١-١
			x	(*x)		(أ) المشروبات الرائقة (Clear Drinks) المياه ، شراب تفاح ، عصائر رقيقة للفاكهة أو الخضار الطبيعية أو المركزة، نكتار الفاكهة ، مشروب الليمون، الأشرية ، المشروبات المرة، مشروب متحصل عليه بالنقع ، الشاي والقهوة ، البيرة ، المشروبات الغازية ، مشروبات الطاقة وما شابهها ، المياه المنكهة ، مستخلص القهوة السائل .	
		x		(*x)		(ب) المشروبات المحتوية على جزيئات معيقة (Cloudy Drinks) العصائر والنكتار والمشروبات الغازية المحتوية على لب فاكهة، عجائن الفاكهة (Musts) المحتوية على لب فاكهة، الشوكولاته السائلة .	
			x			المشروبات الكحولية ذات محتوى كحولي بين (٦-٢٠٪) حجمًا .	٢-١
		x				المشروبات الكحولية ذات محتوى كحولي أعلى من (٢٠٪) وجميع مشروبات الليكر- قشدية القوام (Liquors Cream) .	٣-١
مستبدل بكحول إيثيلي ٩٥٪				(*x)		متنوعة : كحول إيثيلي غير محول .	٤-١



THANK YOU

