

# Bringing the next piece

Alternatives to DEHP in blood bags



# Can you move away from **DEHP**



## Challenges of blood bag material

Blood bags need to meet strict requirements to guarantee optimal conditions for the collection, processing, storage and transportation of blood components. These containers should be flexible for efficient separation and have a strong resistance against mechanical stress (e.g. centrifugation). They must have a high temperature stability to sustain both steam sterilization and freezing of blood components. Furthermore, blood bags must be transparent to allow visual inspection and content detection during processing. They should be bio- and hemocompatible to avoid cell damage or cell activation. An appropriate gas permeability is necessary to allow extended storage of blood components.<sup>1</sup>

## Role of plasticizers in blood bags

Plasticizers make PVC material flexible, easy to handle and resilient to physical and thermal stress. DEHP is a plasticizer widely used to give PVC material the required characteristics.

## European Union vision

In preparation for the potential phase-out of DEHP in the European Union, Fresenius Kabi developed blood bag systems containing less than 0.1% of DEHP by weight of the plasticized material in accordance with Regulation (EC) 1907/2006 (REACH).

## Our mission

We, at Fresenius Kabi, are dedicated to providing high-quality products for the therapy and care of critically and chronically ill patients. In our continuous mission to provide safe and efficient medical devices, Fresenius Kabi is constantly working to replace DEHP with alternative plasticizers.

## Bringing the next piece to the puzzle

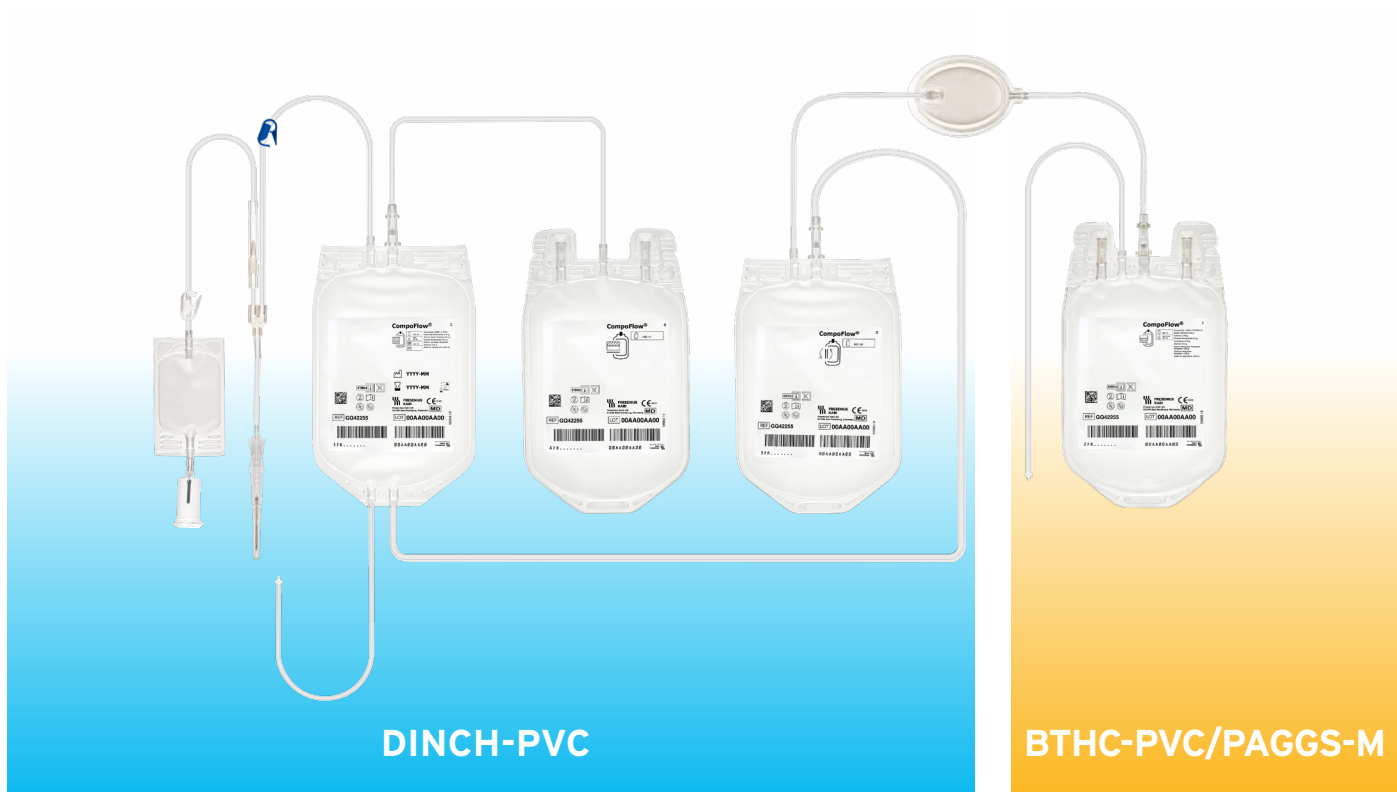
Thanks to a smart combination of carefully selected blood bag materials and storage solution, we now offer an RCC in-line system not made with DEHP material.\* This new product is the next puzzle piece in finding alternatives to DEHP in our blood bag portfolio. It allows blood processing under unchanged conditions, including storage of red blood cells up to 42 days in PAGGS-M. Initial in vitro and in vivo studies have shown promising results on the quality of blood components in compliance with EDQM guidelines.<sup>2</sup>



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\*containing less than 0.1% of DEHP by weight of the plasticized material in accordance with Regulation (EC) 1907/2006 (REACH).

# ...but not **quality?**



Red blood cells prepared with our new RCC in-line system were evaluated in pre-clinical and clinical conditions. Below are the results of this study.

## PRE-CLINICAL EVALUATION

Whole blood collection bag RBC storage bag Storage solution	DEHP-PVC DEHP-PVC SAG-M (n = 30)	DINCH-PVC BTHC-PVC PAGGS-M (n = 30)
<b>DAY 1</b>		
Hb (g/L)	193 ± 10 (194)	194 ± 5.9 (194)
Hct (L/L)	0.61 ± 0.03 (0.61)	0.63 ± 0.02 (0.63)
MCV (fL)	95 ± 6.0 (97)	99 ± 4.0 (99)
ATP (µmol/g Hb)	5.7 ± 0.6 (5.1)	5.1 ± 0.5 (5.1)
<b>DAY 42</b>		
Hct (L/L)	0.65 ± 0.02 (0.65)	0.64 ± 0.02 (0.64)
MCV (fL)	103 ± 5.4 (104)	101 ± 4.2 (102)
Haemolysis (%)	0.36 ± 0.17 (0.33)	0.38 ± 0.12 (0.37)
ATP (µmol/g Hb)	3.3 ± 0.5 (3.4)	3.9 ± 0.5 (4.0)
DEHP (mg/L)	27.6 ± 7.9 (25.3)	<0.1
BTHC (mg/L)	Not determined	9.6 ± 1.8 (9.3)
DINCH (mg/L)	Not determined	2.9 ± 1.2 (2.4)

This study shows that the in vitro quality of red cells collected in DINCH/BTHC-PVC hybrid blood bag system and stored in PAGGS-M/BTHC-PVC is equivalent to that of red cells stored in SAG-M/DEHP-PVC.<sup>2</sup>

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Data shown as mean ± SD (median).

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## Why is it important to maintain the storage time of RBC as long as possible?

- The safety of patients relies on the stability of RBC supply.<sup>5</sup>
- Extended shelf-life limits wastage by reducing the number of outdated RBC to be discarded.<sup>6</sup>
- It helps minimize the risk of blood shortages in case of unpredictable events (e.g., pandemics) and during seasonal fluctuations (e.g., holidays).<sup>5</sup>

## CLINICAL EVALUATION

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**Through the haemovigilance surveillance, we established that the incidence of transfusion reactions for red cells stored in PAGGS-M/BTHC-PVC did not exceed that of those stored in SAG-M/DEHP-PVC.<sup>2</sup>**

The encouraging outcomes of these studies lay the foundation for further research into hybrid blood bag systems made with DINCH/BTHC-PVC. The collection of data on the impact of secondary processing steps, such as, but not limited to, irradiation, will be part of upcoming studies.



# ...but not **quality?**



## **DINCH-PVC**

Plasticizer with comparable flexibility and mechanical properties as DEHP-PVC  
Validated for collection and processing of whole blood including storage of platelets and plasma<sup>3</sup>

## **BTHC-PVC**

Second-generation plasticizer  
Proven safety and efficacy for RBC storage<sup>2</sup>

## **PAGGS-M**

Enhanced storage solution  
Provides improved RBC stability during storage compared to SAG-M<sup>4</sup>

**Introducing new evidence on  
alternatives to DEHP in blood bags**

# Ordering information

A selection of RCC in-line blood bag systems with different specifications are available for your individual requirements. Additional article codes are available on request.

For more information such as literature, technical details and working procedures, please contact your local sales representative.

## New Blood Bag Portfolio

Article	Code	Description	Quantity per box
Composelect Quadruple	FQ42250	T&B 63 ml CPD/100 ml PAGGS-M - RCC + PDS-V	24 pcs/box
Composelect Quadruple	FQ42271	T&B 70 ml CPD/110 ml PAGGS-M - RCC + PDS-V	24 pcs/box
CompoFlow Quadruple	GQ42250	T&B 63 ml CPD/100 ml PAGGS-M - RCC + PDS-V	24 pcs/box
CompoFlow Quadruple	GQ42255	T&B 63 ml CPD/100 ml PAGGS-M - RCC + PDS-V wide bore	24 pcs/box
CompoFlow Quadruple	GQ42271	T&B 70 ml CPD/110 ml PAGGS-M - RCC + PDS-V	24 pcs/box

## References

1. ISO 3826-1
2. Vermeulen C et al. Vox Sanguinis. 2022;117:1163-1170.
3. Lagerberg JW et al. Transfusion. 2015;55:522-31.
4. Lagerberg JW et al. Blood Transfus 2017; 15: 456-62.
5. Stanworth SJ et al. Lancet Haematol 2020;7: e756-64.
6. Hutspardol S et al. Vox Sanguinis. 2023;1-8.

## Abbreviations

<b>ATP</b>	adenosine triphosphate	<b>PAGGS-M</b>	phosphate-adenine-glucose-guanosine-saline-mannitol
<b>BTHC</b>	n-butyryl-tri-n-hexyl citrate	<b>PVC</b>	polyvinyl chloride
<b>CPD</b>	citrate phosphate dextrose	<b>RBC</b>	red blood cell
<b>DEHP</b>	bis(2-ethylhexyl) phthalate	<b>RCC</b>	red cell concentrate
<b>DINCH</b>	1,2-cyclohexane dicarboxylic acid diisononyl ester	<b>REACH</b>	Registration, Evaluation, Authorisation and Restriction of Chemicals
<b>EC</b>	European Commission	<b>SAG-M</b>	saline-adenine-glucose-mannitol
<b>EDQM</b>	European Directorate for the Quality of Medicines & HealthCare	<b>T&amp;B</b>	top & bottom
<b>Hb</b>	hemoglobin	<b>PDS-V</b>	pre donation system with vacutainer
<b>Hct</b>	hematocrit	<b>SD</b>	standard deviation
<b>MCV</b>	mean corpuscular volume		

This marking reflects compliance with the applicable CE Marking requirements for medical devices. 