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Inclusion of *Batch Expiration* in Material Requirement Planning

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Abstract -_This limitation is particularly critical in life sciences industries**—including pharmaceuticals, chemicals, and food—where materials have finite shelf lives and replenishment lead times often extend across the planning horizon. In such environments, failure to incorporate batch expiry into planning undermines MRP's core objective of ensuring "Guaranteed material availability on time"**

Expiry Management of costly raw materials play an important role in pharmaceutical and chemical industry for manufacturing cost controlling. However,Standard Material Requirements Planning (MRP) engines perform net requirement calculations by evaluating demand and supply elements by arranging them as time series data—such as stock, purchase orders, production orders, and planned orders—within a defined planning horizon. However, conventional MRP systems do not account for batch-level inventory attributes**, including expiry date, shelf life, and "use-by" constraints. As a result, materials that are technically available in stock but approaching or exceeding expiry are still considered usable, leading to** production disruptions and material shortages **despite regular MRP runs.**

This white paper presents an enhanced MRP solution can be leveraged in global ERP transformation for pharmaceutical /Chemical companies. The solution extends standard MRP logic by incorporating material, plant, and batch-level granularity**, enabling net requirement calculations that dynamically consider batch expiry timelines. The approach excludes expired or soon-to-expire inventory from planning relevance and proactively generates procurement or production proposals to mitigate shortages. Additionally, it introduces enhanced visibility of batch expiry within stock requirement reporting.**
The implementation of this solution resulted in annual savings of approximately $25 million per plant **and has since been incorporated into the global ERP solution template for enterprise-wide deployment.**
This paper addresses a longstanding gap in enterprise planning systems and provides a scalable framework for integrating batch-level expiry into MRP, helping organizations optimize inventory utilization, reduce waste, and ensure uninterrupted manufacturing operations.

SOLUTION ILLUSTRATION FOR ERP SYSTEM AS SAP.

MRP engine is the most important and complex component in SAP's production planning module. Also this would help SAP developers and consultants simplified framework to enhance MRP program to suffice client's need.
Before going into further technical details of the blog, let us understand few key elements of planning.

Note (This concept can be leveraged for any ERP business system implementation.)

WHAT IS MRP ENGINE IN ERP?

The **MRP engine (Material Requirement Planning)** is used to plan procure or produce the required material quantities on time for in-house purpose or for fulfilling customer demands or forecasted volume. In manufacturing, the function of MRP is to guarantee material availability on time. MRP engine plans the supply based on requirements and considering the current stock in hand and meets the shortages.

Time Phased Net requirements= Time phased Gross requirements- (scheduled receipts+ On-hand inventory)
We calculate this value meticulously by looking into the scheduled receipts and on-hand stock over the planning horizon. Please refer Fig – 2 & 3 to see Time Phased net requirement calculation.

What is Self Life and Expiry date ?

As per 21 CFR Part 211 - Good Manufacturing Practice for Finished Pharmaceuticals established requirements concerning the expiration date on a drug product and stability testing to assure the appropriateness of that date. Each Chemicals or drug products or APIs(Active pharmaceutical) chemical and physical properties retains its permissible characteristics up finite number days which is determined empirically basis by clinical and laboratorial experiments and trails.
Expiry Date = Date of Manufacturing + Shelf Life (usually maintained in number days)

What is Time phased Net requirement Calculation?

In simple terms, we add up the orders scheduled to arrive and the material we have in store and then subtract it from the gross requirements. After netting, this value is the total amount of materials we need for the next production cycle. Again, a simple net requirements formula can explain that.

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Refer to Figure 1.0 to understand the standard MRP process for calculating net requirements and generating planning proposals based on demand, without accounting for batch expiration.

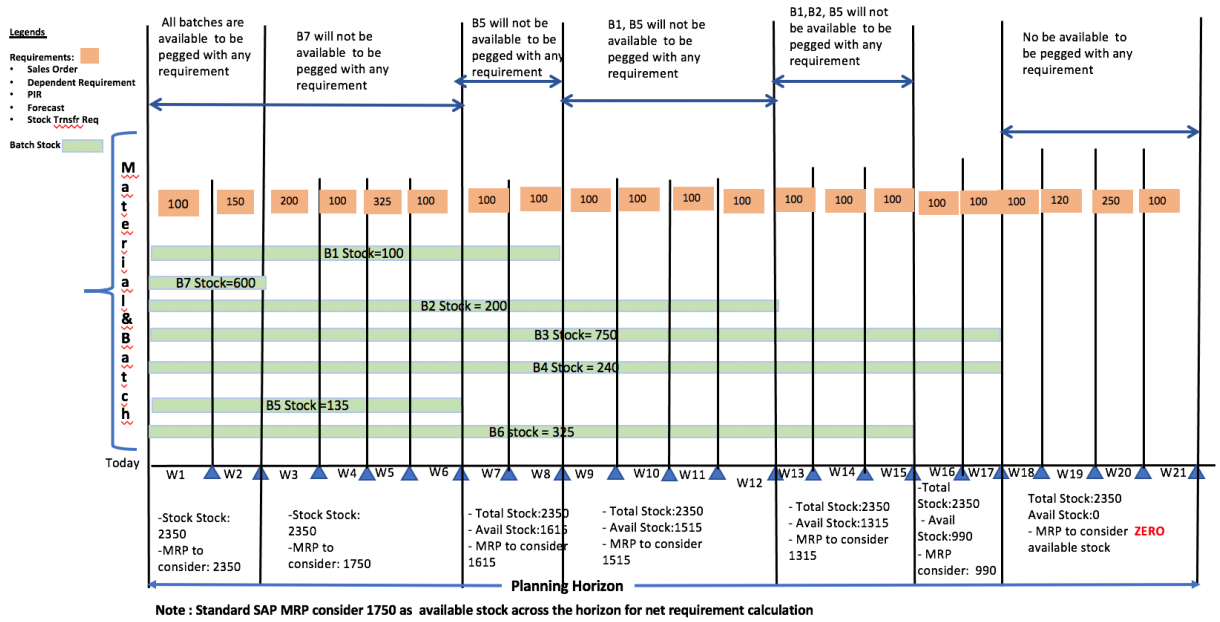

Fig. 1.0 -Time phased available stock for MRP

Refer to Figure 2.0 to understand the standard MRP process for calculating net requirements and generating planning proposals based on demand and accounting for batch expiration.

Standard. SAP MRP. Calculation

	W1	W2	W3	W4	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16	W17	W18	W19
Gross Stock	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350
Gross Available Stock for MRP	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350
Firmed receipts	10	-	-	-	-	25	-	-	-	-	-	-	-	-	-	20	-			
Demand	100	150	200	100	325	100	100	100	100	100	100	100	100	100	100	100	100	120	250	100
Time phased Net Requirement	- 2260	- 2110	- 1910	- 1810	-1485	-1410	-1310	-1210	-1110	-1010	-810	-710	-610	-510	-410	-330	-230	-110	140	100
Planned Order	0	0	0	0	0	0	0	0	0	0	0	0	0	0	140	100	0	0	0	0

Showing excess Inventory

Replenishment Lead time of 4 weeks

Basic Assumption
Planning Horizon : 19 weeks
Replenishment lead time : 2 weeks

Fig. 2.0 -Time phased Net Requirement Calculation and Standard MRP results

Refer to Figure 2.0 to understand the standard MRP process for generating planning proposals based on demand, considering batch expiration.

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Enhanced SAP MRP Result

	W1	W2	W3	W4	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16	W17	W18	W19
Stock	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350
Expired Batched	-	-	600	-	-	-	135		-	100	-	-	200	-	-	325	-	990	-	-
Gros. Available Stock for MRP	2350	2350	2350	1750	1750	1750	1750	1615	1615	1615	1515	1615	1615	1315	1415	990	990	0	0	0
Firmed receipts	10	-	-	-	-	25	-	-	-	-	-	-	-	-	-	20	-			
Demand	100	150	200	100	325	100	100	100	100	100	100	100	100	100	100	100	100	120	250	100
Time phased Net requirement	-2260	-2110	-1300	-1200	-875	-800	-565	-465	-365	-165	-65	35	100	100	100	100	100	120	250	100
Planned Order	0	0	0	0	0	0	35	100	100	100	100	100	120	250	100	100	0	0	0	0

Expiring Batch

Ture available Inventory

Replenishment Lead time of 4 weeks

Basic Assumption
Planning Horizon : 19 weeks
Replenishment lead time : 2 weeks

* Potentially we will have material shortage starting from week 13 onwards. However, standard SAP would not be able to generate planning proposal to ensure material availability on time

Fig. 3.0 -Time phased Net Requirement Calculation and enhanced MRP results

What are the functional requirements to set the context of including batch expiration in MRP ?

1. All batches beyond its future expiry date should not be considered in planning as available stock.
2. Inventory to be spited at further granular level as time series data and Batch should considered as one of MRP element in net requirement calculation.
3. Batch stock and requirements should be pegged using a time-series approach based on **FEFO (First Expiry, First Out)** principles.

4. MRP program should recognize the batch expiration date / used-by date and decrement the availability of stock from Net-requirement calculation such that a planned order / purchase requisition could be generated by MRP run for a requirement for unfulfilled requirement.

5. Then Subtract the calculated quantity left over on or after future expiry date should be excluded from the net available stock in MRP calculation. however batches may exist in the system and until those batches have been written off.

6. Enhance all stock requirement list and MRP list to show batch level stock and line for future dated expired batch as time series.

7. Exclude the materials from this enhancement if the material is not batch mangled or not relevant for expiry.

8. Include only the batches with expiry date fall within the number of days maintained in the material master record field “Maximum Storage Period” from current date.

Key Industry Benefits

1. Eliminates production interruptions caused by material shortages.
2. Enables optimized and more accurate raw material planning.
3. Improves visibility into batch-level inventory, reducing waste of high-value pharmaceutical ingredients and lowering manufacturing costs for life-saving drugs.
4. Promotes environmental sustainability by minimizing waste from expired chemical materials.

SAP admits that it’s does not consider stock at batch granularity while pegging the requirements with supply/receipt elements. Standard SAP considers the expired batch as surplus quantities that are to be disposed of as waste and cannot be pegged to any requirement falling after to be expired batches. The purpose of this enhancement is that MRP planning program should dynamically take balance stock of the expired batches out of time phased **Net requirement calculation**, if those have not been pegged with any requirement before future expiry date. Arrange all issue and receipt elements in time series and expiring the expiring batch quantity

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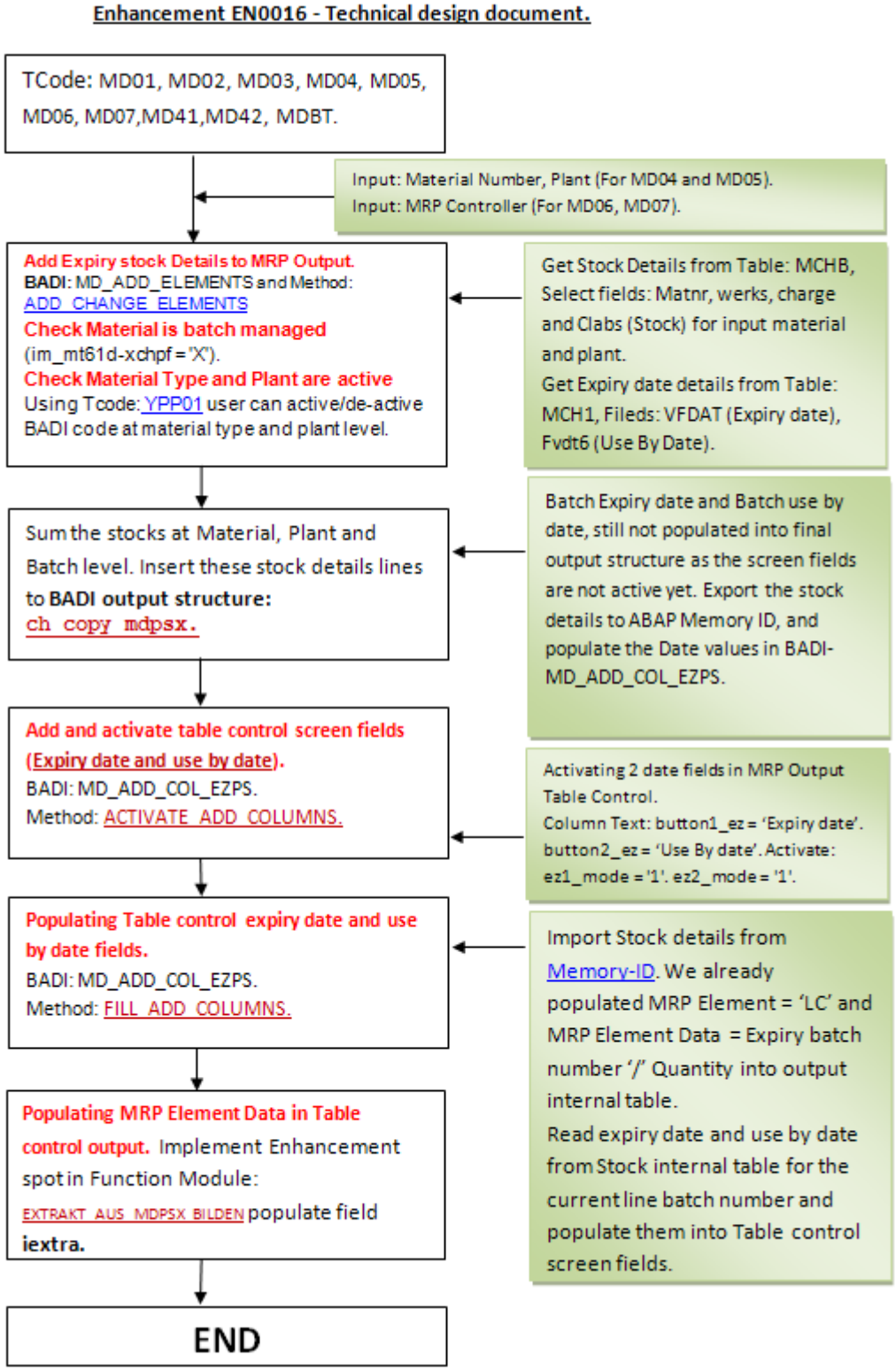
of a batch (for all batches in general) that will expire on the expiration date, by taking into consideration consumptions of the same material before its expiration.

Technical flow to be used for SAP



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- **BADI / Enhancement Spot**

Definition: *MD_ADD_ELEMENTS*
Implementation: *ZPP_MRPMD_ADD_ELEMENTS*
Method: *ADD_CHANGE_ELEMENTS*
Class: *ZCL_IM_PP_MRPMD_ADD_ELEMENTS*

Definition: *MD_ADD_COL_EZPS*
Implementation: *ZPP_MRPMD_ADD_COL_EZPS*
Method: *ACTIVATE_ADD_COLUMNS, FILL_ADD_COLUMNS.*
Class: *ZCL_IM_PP_MRPMD_ADD_COL_EZPS*

Enhancement Spot: ZPP_MRPELE_DT_FILL.

- Pseudo code

- The main transactions – MD01, MD02, MD03, MD04, MD05, MD06, MD07, MD41, MD42,MD43 MDBS, MSBT. Enabling batch as MRP element.
- Implement and activate BADI MD_ADD_ELEMENTS.
- Add following logic in Method: ADD_CHANGE_ELEMENTS.
- Check material is batch managed or not in method import structure im_mt61d-xchpf = 'X'.
- Fetch material type, plant and active flag from custom table ZPP_MRP_EXP_ACT by passing material type and plant and check active flag = ‘X’.
- If the above two statements are valid then fetch MATNR (Material Number), WERKS (Plant), CHARG (Batch) and CLABS (Quantity) from MCHB table for the input material and plant and store details in the internal table.
- Fetch MATNR, BATCH, VFDAT (Expiry date), FVDT6 (Use by Date) from MCH1 table for above selected materials and batches. Store the above details into a internal table T_STOCK.
- Sum the CLABS at MATNR, WERKS and CHARG level.
- Insert above expiry stock lines into Method output structure ch_copy_mdpsx.
  ch_copy_mdpsx-plaab = 2. “Material requirements planning segment
  wa_ch_copy_mdpsx-vrfkz = 'X'. “Availability indicator
  wa_ch_copy_mdpsx-delkz = 'LC'. “MRP element - Batch Stock wa_ch_copy_mdpsx-mng01 = CLABS (Quantity). wa_ch_copy_mdpsx-plumi = '-'. “Receipt/issue indicator
  wa_ch_copy_mdpsx-baugr = concatenate Batch and CLABS (Quantity) separated by ‘/’.
  Populating Receipt/Requirements date.
  - Populate wa_ch_copy_mdpsx-dat00 with Use by date, If Use by date (FVDT6) is not initial or populate with Expiry date (VFDAT).
- Export T_STOCK internal table details to ABAP Memory ID, These details will be used to fill added columns of MRP requirement list output screen.
- Activate the method export flag indicating the MRP output structure changed. ch_changed = 'X'.

Adding and populating additional columns: to MRP output list .

- Implement and activate BADI MD_ADD_COL_EZPS
  Adding additional columns to MRP output list.
- Add following logic in Method ACTIVATE_ADD_COLUMNS.
- Check material is batch managed or not in method import structure imt61d-xchpf = 'X'.
- Fetch material type, plant and active flag from custom table ZPP_MRP_MAT_PLANT_ACTIVE by passing material type and plant and check active flag = ‘X’.
- If above two statements are valid then.

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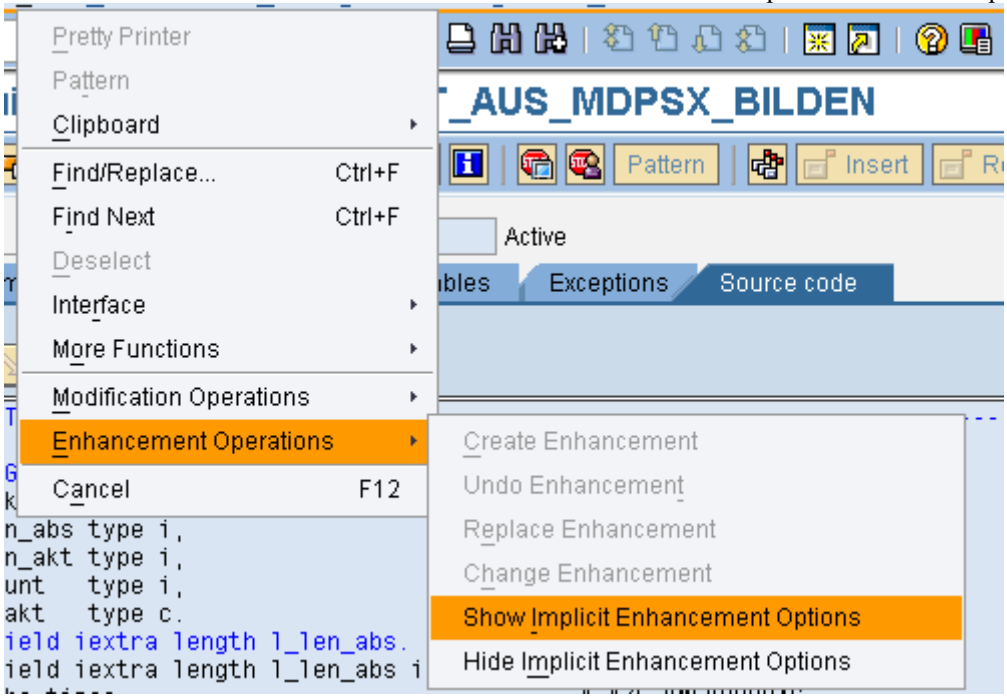
- ✓ Add two columns to the MRP output list. ez1_mode = ez2_mode = '1'.
- ✓ Add column headings to the added columns. button1_ez = 'Expiry Date' and button2_ez = 'Use By Date'.

Populating additional columns to the MRP output list.

- Add following logic in Method d: FILL_ADD_COLUMNS.
- Check material is batch managed or not in method import structure imt61d-xchpf = 'X'.
- Fetch material type, plant and active flag from custom table ZPP_MRP_MAT_PLANT_ACTIVE by passing material type and plant and check active flag = 'X'.
- If TCodes equals 'MD05' and 'MD06', the following logic will be executed
- Import ABAP Memory ID and store it in the internal table T_STOCK, Which is exported in BADI MD_ADD_ELEMENTS.
- Read batch number from internal table T_STOCK with current MRP line in the method export structure ie3mdpslx-baugr.
- Convert Expiry date (T_STOCK-VFDAT) and Use by date(T_STOCK-FVDT6) into external date format using function module 'CONVERT_DATE_TO_EXTERNAL' and store these values into method export fields emdezx_usex1 and emdezx_usex2.
- For TCodes other than MD04 and MD07, the following logic will be executed.
- Get batch number from the method import field ie3mdpslx-baugr. Use the function module 'ISM_SPLIT_STRING' to split the batch and quantity,
- Fetch expiry date (MCH1-VFDAT) and Use by date (MCH1-FVDT6) from table MCH1 by passing material number (imt61d-matnr) and Batch.
- Convert Expiry date (MCH1-VFDAT) and Use by date (MCH1-FVDT6) into external date format using function module 'CONVERT_DATE_TO_EXTERNAL' and store these values into method export fields emdezx_usex1 and emdezx_usex2.

Populating MRP Element Data field in Stock/Requirement List and MRP output list.

- Implement enhancement spot in the function module 'EXTRAKT_AUS_MDPSX_BILDEN' to populate MRP Element data files. Click Enhancement source code button and click on show implicit enhancement option.



- Right click on implicit Enhancement spot and click on create. Give Enhancement implementation name ZPP_MRPELE_DT_FILL.

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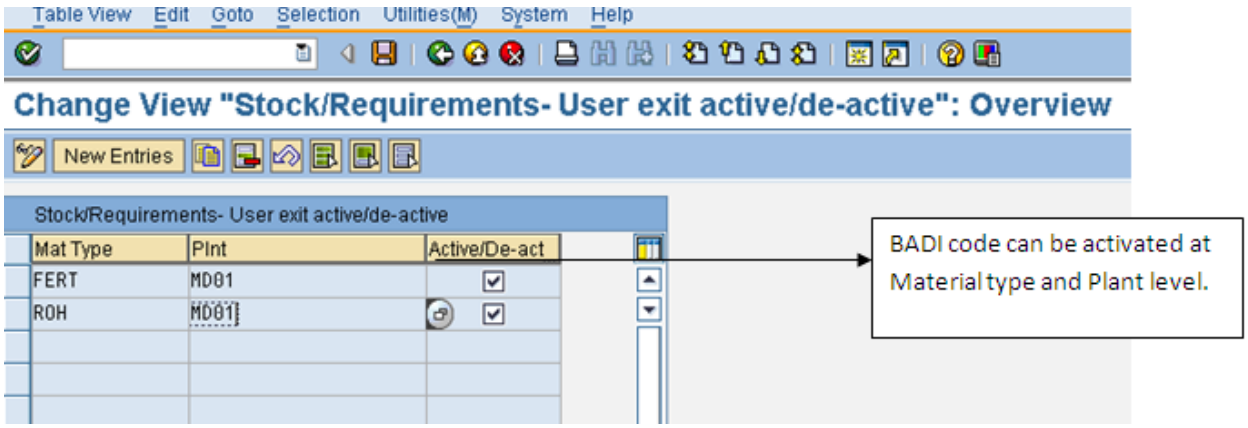
- Check if current line is expiry stock line ('LC') and (TCODE = 'MD04' or 'MD05' or 'MD06' or 'MD07' or 'MD41' or 'MD42' or 'MDBT') and EMDPS-BAUGR (BATCH '/' quantity value populated in BADI MD_ADD_ELEMENTS) is not initial.
- MOVE EMDPS-BAUGR TO iextra.

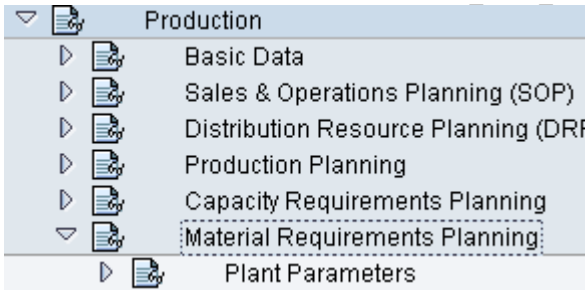
Creating Custom Table to restrict enhancement at Material type and Plant level.

- Create a custom maintainable table ZPP_MRP_EXP_ACT (Name will be changed based on Coding standards) with the following field – MTART, WERKS and ACTIVE_FLAG.
- Create a TCODE YPP01 (Name will be changed based on Coding standards) for maintaining table.



Adding a node in SPRO Screen to maintain the table ZPP_MRP_EXP_ACT**.**

- Create a node for table maintenance of ZPP_MRP_EXP_ACT in the following path of TCODE SPRO.



- Use TCODE SIMGH to create a node in SPRO->Production->Material Requirements Planning. Steps to create a node in SPRO explained in the attached document.

Post implementation Value proposition

1. This enhancement reduced the 80% material shortage related problem of API(Pharmaceutical active ingredient) manufacturing units.
2. Also help in reducing wastage of expensive API and other chemicals
3. This solution add 25 M USD worth of value in their major manufacturing facilities.

Transaction level Illustration

User can see demand and supply situation at batch level granularity where the system automatically consumes the batches and reduce the 'net available material qty' per requirement date from those batches whose expiration date is less than the requirement date.

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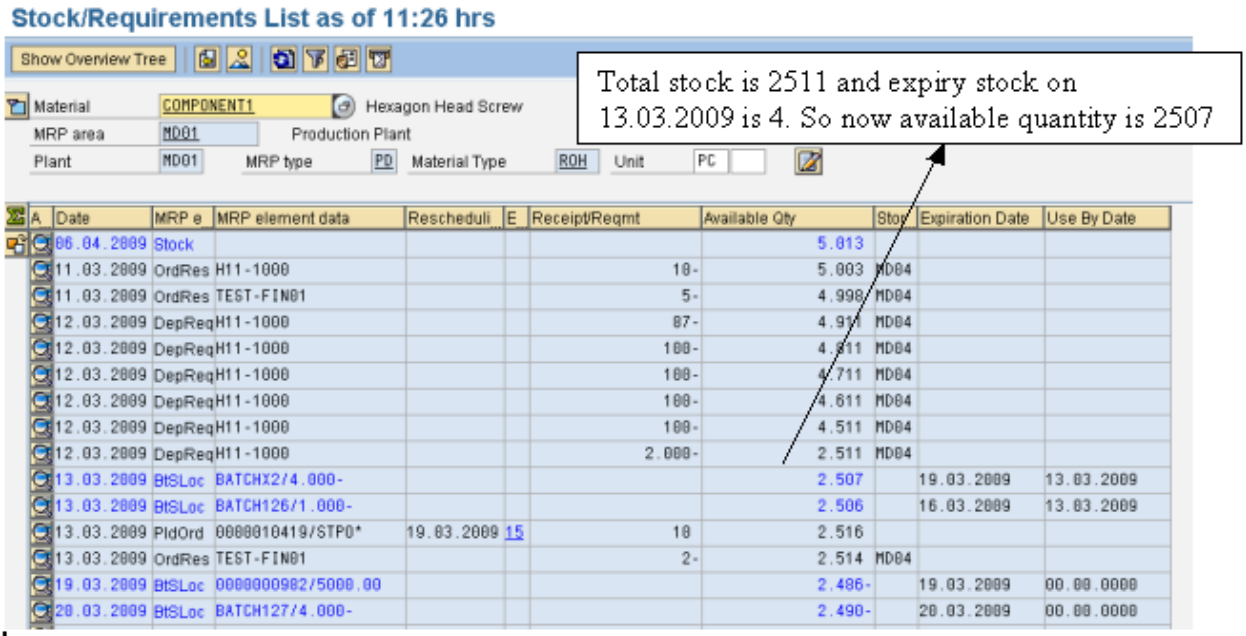
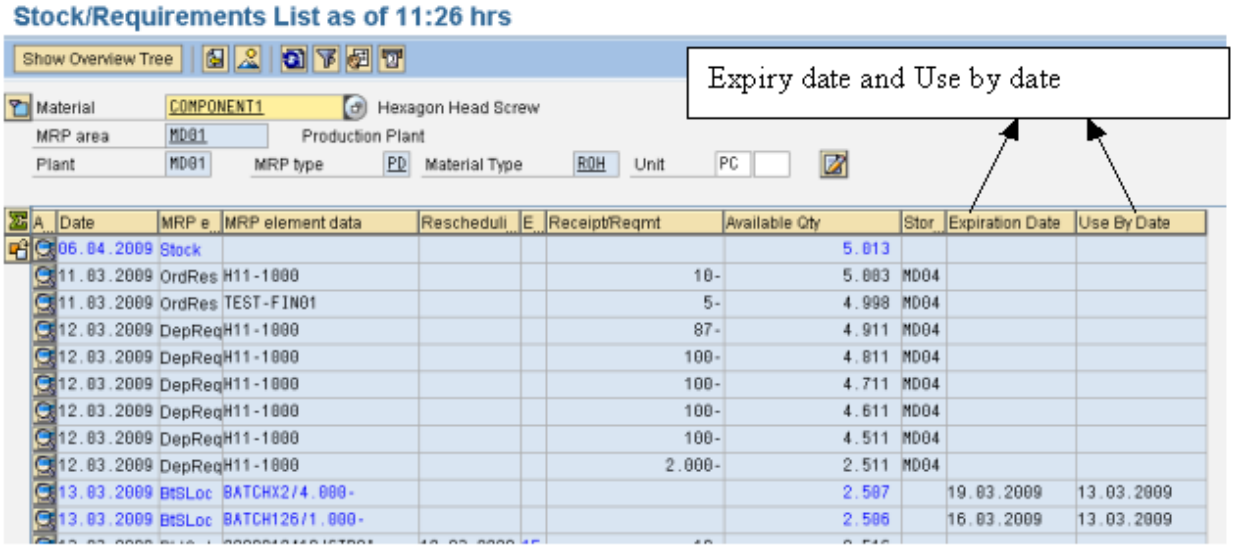


Batch expiry date and use by date are to be displayed in additional columns in the Stock requirements list (MD04, MD07) & MRP list (MD05, MD06).



Batch numbers of the expired batches and their quantities are to be displayed in the batch line (MRP Element) on the MRP Results/Evaluation Screen.

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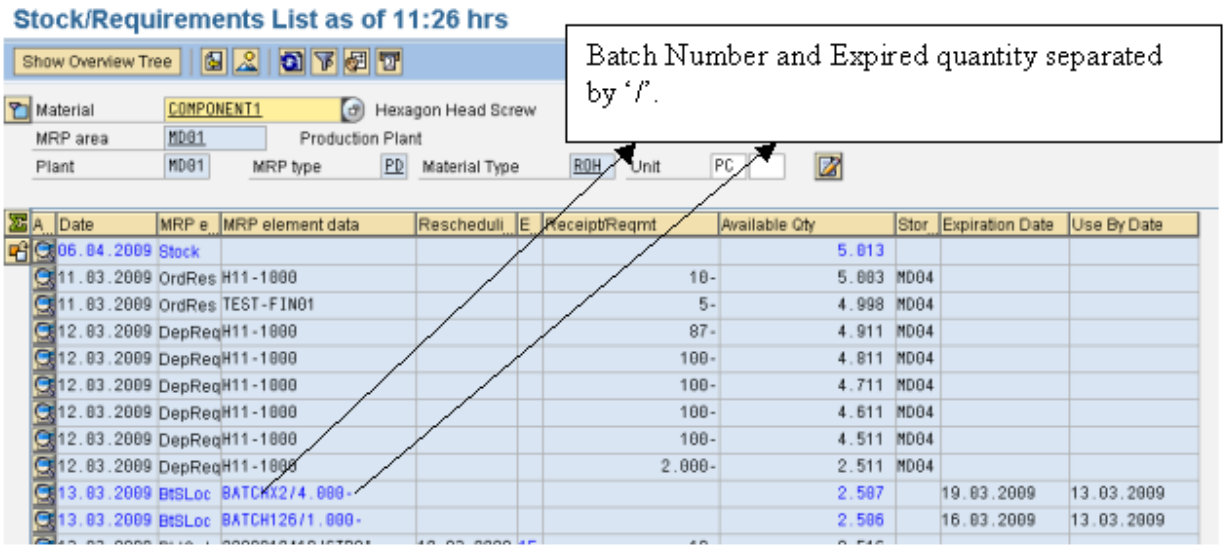

On an average typical global pharmaceutical/Chemical companies incur 6% to 10% waste due to expiry which is worth about few hundred million USD. This use case not only helps to solve batch expiry issues in SAP and but also provide a comprehensive framework to enhance standard SAP's MRP functionality to suffice customized business needs.