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Process Monitoring Outline

- ☺ Process Monitoring Terms
- ☺ Basic Process
- ☺ Why Replenishment
- ☺ How to establish aims
- ☺ Running and plotting control strips
- ☺ Mixing chemicals
- ☺ Trouble shooting

Process Monitoring Terms

- Control Strip: Pre-exposed strips from the paper/film manufacturer. Used to monitor your process

- Reference Strip: Pre-exposed and pre-processed strips from the paper/film manufacturer. Used to generate aim values in which you compare your control strip to.

- Code: Represents reference strips and control strips that are from the same batch.

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Process Monitoring Terms

- Correction factors: Numbers that you add or subtract from the reference strip densities to obtain proper aim values.

- Aim values: the standard densities from your corrected reference strip to which you compare the control strip.

- Y-55 Form: Graph paper on which you plot your process control results.

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Process Monitoring Terms

- Action limits : “Early warning limits”. The process is in control but some type of corrective action should be taken to bring it closer to the aim values.

- Control limits : Stop production. The process is out of control. If corrective action is not taken, it could have an adverse impact on the quality of the product being produced.

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Process Monitoring Terms

- Trend : A slow deviation in the control plots that happens over a period of time. Usually caused by replenishment rates, oxidation, evaporation or a slow “leaching contamination”.

- Event : A sudden deviation in the control plots. Usually caused by wrong code control strip, densitometer shift, misread control strip, sudden change in time, sudden change in the temperature, contamination or mixing errors.

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Process Monitoring Terms

- Specific gravity : The ratio of the mass of a liquid to the mass of an equal volume of water. Water has a specific gravity of 1.00. Measuring specific gravity can give a relative determination of the total amount of solids dissolved in solution. It is very useful in checking for mix errors and replenishment errors.
- pH : The measure of the hydrogen ion activity in a solution. A pH less than 7.00 is an acid, a pH greater than 7.00 is an alkali. pH is very useful in determining the activity of photographic chemicals.

Process Monitoring Terms

- Replenishment solution : Chemicals that are introduced into the working tank solution to maintain its activity and compensate for volume loss.

- Working tank solution : The actual chemicals in the processor that are being used to process the film or paper.

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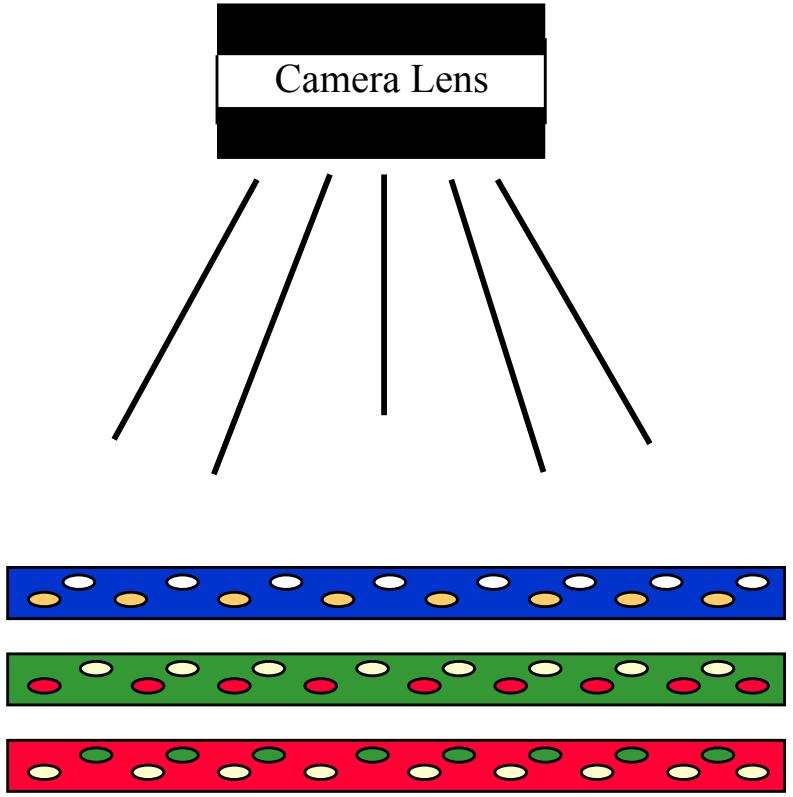
C-41 Development Process

Photographic film has three emulsion layers (B, G, R) that are composed of silver halide crystals (AgBr) and the corresponding color couplers. The silver halide is light sensitive and forms a latent image upon exposure.



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C-41 Development Process

The developer converts the exposed silver halide crystals (latent image) to metallic silver. The active developing agent (ADA) is also converted to an oxidised developing agent (ODA) at this time. The oxidised developing agent combines with the color couplers to form a dye image in each of the three color layers. The amount of dye image formed is dependent on the amount of exposure given to the film and the chemical activity of the developer.

As an example :

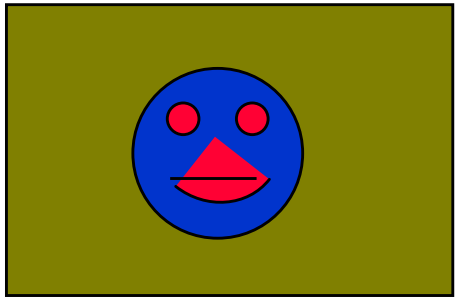
C-41 Development Process

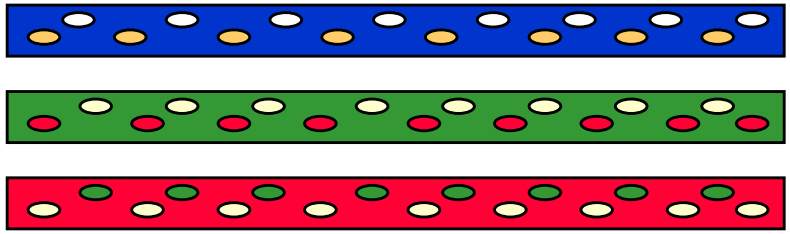
ADA + AgBr → Ag + ODA^{+} + Br

ODA + CC → Dye Image

ADA + ⬭ Silver Bromide = ODA

ODA + 🟡 🔴 🟢 Color Couplers = Dye Formation





C-41 Development Process

The low pH of the bleach stops the development process. The bleach converts the metallic silver into a soluble silver compound. This conversion is necessary for proper fixing of the film.

$$Ag^0 + Fe^{3+} + NH4BR \rightarrow AgBr + Fe^{2+}$$

The fixer dissolves (complexes with) the soluble silver along with any remaining silver halide that was not affected by development. The dissolved silver is removed from the film into the fixer tank solution.

$$2(NH_4)_2S_2O_3 + AgBr \rightarrow (NH_4)_3\{Ag\,(S_2O_3)_2\} + NH_4Br$$

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C-41 Development Process

The stabilizer :

- hardens the emulsion.
- stabilizes the dyes.
- reduces the formation of water spots.
- removes residual fixer in a washless system.

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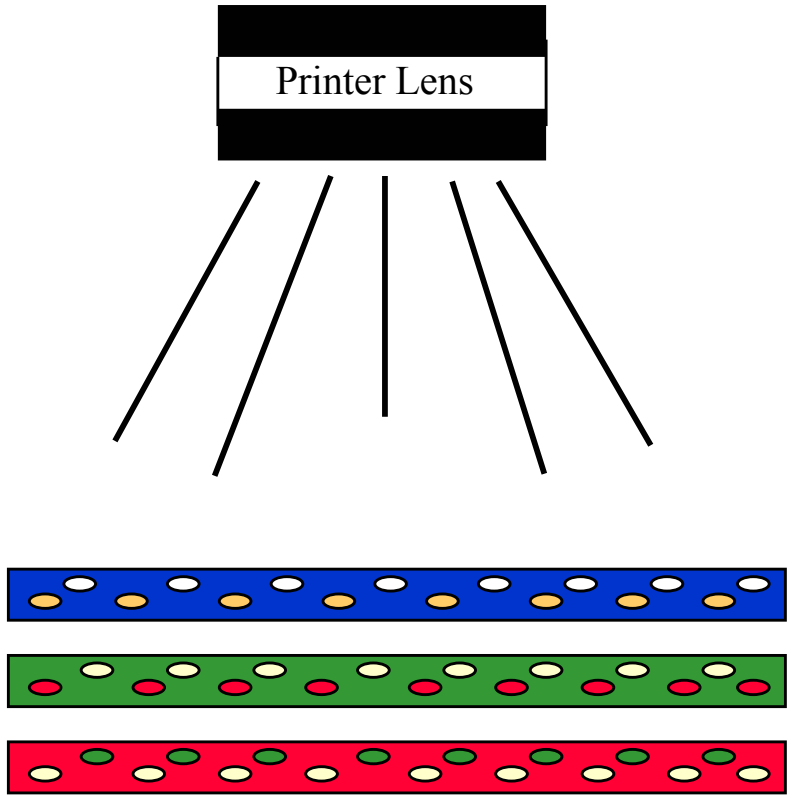
RA-4 Development Process

Photographic paper has three emulsion layers (R, G, B) that are composed of silver halide crystals (AgCI) and the corresponding color couplers. The silver halide is light sensitive and forms a latent image upon exposure.



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RA-4 Development Process

The developer takes the exposed silver halide crystals (latent image) and converts them to metallic silver. The active developing agent (ADA) is also converted to an oxidised developing agent (ODA) at this time. The oxidised developing agent combines with the color couplers to form a dye image in each of the three color layers. The amount of dye image formed is dependent on the amount of exposure given to the paper and the chemical activity of the developer.

As an example :

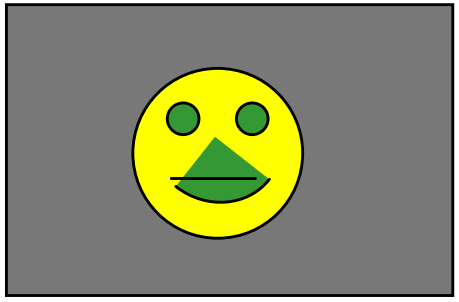
RA-4 Development Process

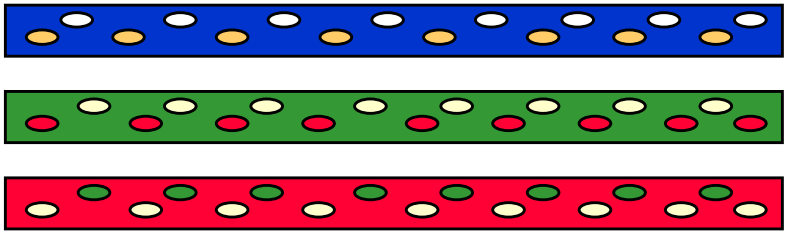
$$ADA + AgCl \rightarrow Ag + ODA^{+} + Cl^{-}$$

$$ODA + CC \rightarrow \text{Dye Image}$$

ADA + ⬭ Silver Chloride = ODA

ODA + 🟡 🔴 🟢 Color Couplers = Dye Formation





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RA-4 Development Process

The bleach-fix is a combined solution of bleach and fixer. The low pH stops the development process. The bleach converts the metallic silver into a soluble silver compound. The fixer dissolves (complexes with) the soluble silver along with any remaining silver halide that was not affected by development. The dissolved silver is removed from the paper and goes into the bleach-fix tank solution.

$$Ag^0 + Fe^{3+} \rightarrow Ag^+ + Fe^{2+}$$

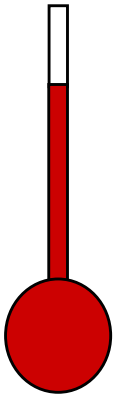
$$2(NH_4)_2S_2O_3 + Ag^+ \rightarrow (NH_4)_3\{Ag\,(S_2O_3)_2\} + NH_4^+$$

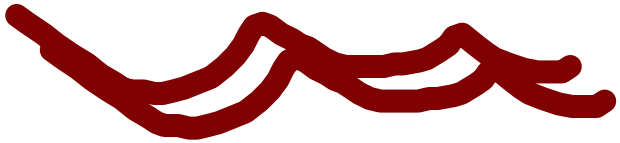
RA-4 Development Process

The wash water (or print rinse) removes the residual bleach-fix and soluble silver from the paper.

(For washless applications, the print rinse also stabilizes the dyes in the paper).

How is the process controlled ?

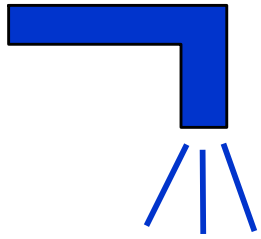


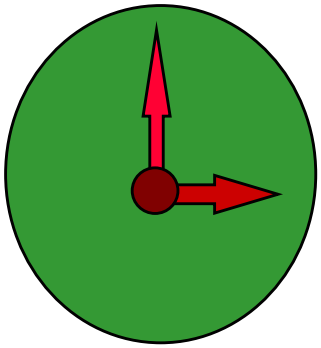


T - Temperature

A - Agitation/Circulation

R - Replenishment (Chemical Strength)





T - Time

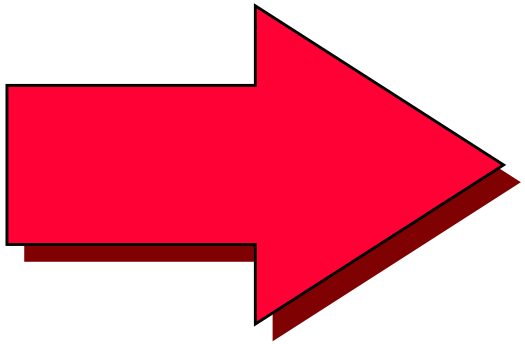
Also Processor Mechanics

Why replenishment ?

During processing, the processor working tank solutions lose their ability to function properly. This is primarily due to exhausted chemistry and the build-up of emulsion by-products.

To compensate, a replenisher is used. Replenishing is a method of replacing (“rejuvenating”) the working tank solution and diluting out unwanted by-products.

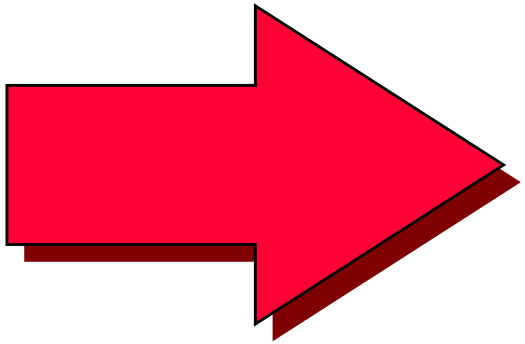
Why replenishment ?



C-41 Developer

pH decreases
ADA is consumed
Potassium bromide increases
Loss in tank volume (carry-out)
Oxidation occurs

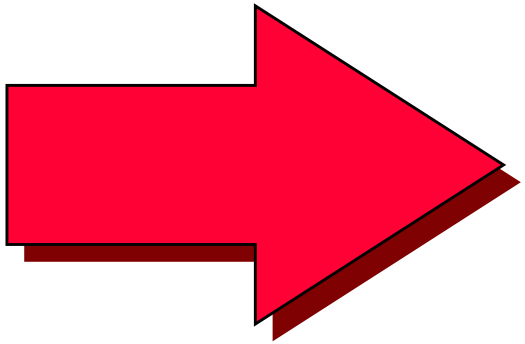
Why Replenishment ?



C-41 Bleach

pH Increases
Solution is diluted with carry-in
Less Iron
Less ammonium bromide
Oxidation occurs (ADA/ODA)

Why Replenishment ?



C-41 Fixer

pH decreases
Solution is diluted with carry-in
Less ammonium thiosulfate
Oxidation occurs

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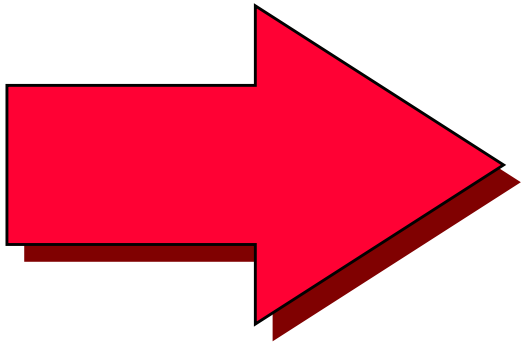
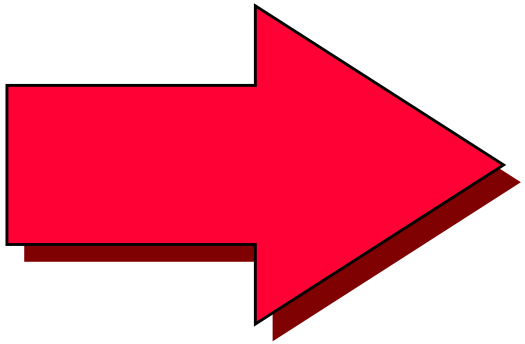
Why Replenishment ?



C-41 Stabilizer

Solution is diluted with carry-in
Formaldehyde is consumed
Excessive residual fix
in a washless system

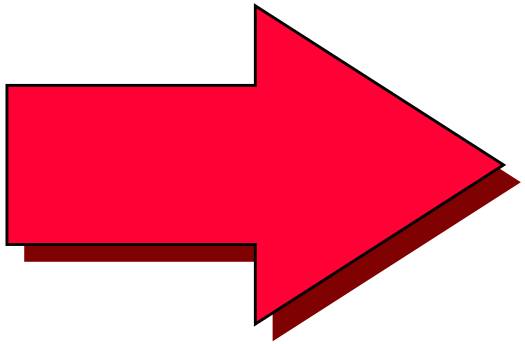
Why Replenishment ?



RA-4 Developer

pH Decreases
ADA is consumed
Potassium chloride increases
Loss in tank volume (carry-out)
Oxidation occurs

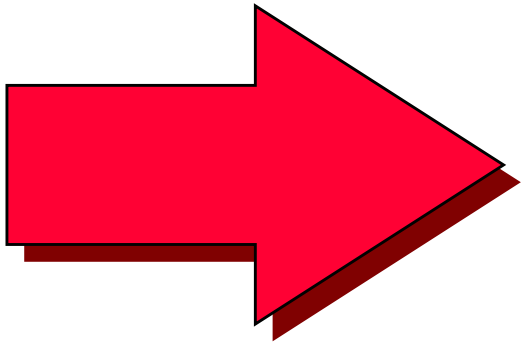
Why Replenishment ?



RA-4 Bleach-Fix

pH Increases
Solution is diluted with carry-in
Less Iron
Less ammoniumthiosulfate
Oxidation occurs

Why Replenishment ?



RA-4 Final Wash/Super Stabilizer

Solution is diluted with carry-in
Excessive residual bleach-fix

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How to establish RA-4 Aims

- Read and record the R, G & B densities for D-min (stain), LD, HD, and D-max (black patch) on the reference strip. You can average strips from the same code if you have several boxes. (Is densitometer calibrated ?)
- Add or subtract the correction factors for that particular code.
- Subtract LD from HD to achieve the aims for contrast (HD-LD).
- The corrected density values for D-min, LD and D-max are the aim values for those parameters.
- Record the code number on the Y-55 form.
- Record the aim values on the Y-55 form.
- Draw in the action/control limits on the Y-55 form.
- Black = Action, Red = Control.

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RA-4 Aim Values

	R	G	B
D-max (BP)	_____	_____	_____
C.F.	_____	_____	_____
AIM	_____	_____	_____
Contrast (HD-LD)	_____	_____	_____
HD (w/cf)	_____	_____	_____
LD (w/cf)	_____	_____	_____
AIM	_____	_____	_____

	R	G	B
HD	_____	_____	_____
C.F.	_____	_____	_____
AIM	_____	_____	_____
LD	_____	_____	_____
C.F.	_____	_____	_____
AIM	_____	_____	_____
D-min	_____	_____	_____
C.F.	_____	_____	_____
AIM	_____	_____	_____

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How to establish C-41 Aims

- Read and record the R, G & B densities for D-min, LD and HD on the reference strip. Read and record the D-max B on the blue channel. Also read and record the YB patch on the blue channel. Read and record the D-max R and D-max G on the bleach monitoring reference strip.
- You can average strips from the same code if you have several boxes. (Is densitometer calibrated ?)
- Add or subtract the correction factors for that particular code.
- Subtract LD from HD to achieve the aims for contrast (HD-LD).
- The corrected density values for D-min and LD are the aim values for those parameters.
- Subtract YB from D-max B. This is the retained silver aim.
- Subtract D-max G from D-max R. This is the leuco cyan aim. In some cases these values come from the bleach monitoring reference strip.
- Record the code number on the Y-55 form.
- Record the aim values on the Y-55 form.
- Draw in the action/control limits on the Y-55 form.
- Black = Action, Red = Control.

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C-41 Aim Values

	R	G	B
D-max (BP)	_____	_____	_____
C.F.	_____	_____	_____
AIM	_____	_____	_____
Contrast (HD-LD)	_____	_____	_____
HD (w/cf)	_____	_____	_____
LD (w/cf)	_____	_____	_____
AIM	_____	_____	_____

	R	G	B
HD	_____	_____	_____
C.F.	_____	_____	_____
AIM	_____	_____	_____
LD	_____	_____	_____
C.F.	_____	_____	_____
AIM	_____	_____	_____
D-min	_____	_____	_____
C.F.	_____	_____	_____
AIM	_____	_____	_____

Retained Silver, D-Max B - YB (W/cf) _____

Leuco Cyan, Dmax R - Dmax G (W/cf) _____

May need bleach monitoring strip

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Action and Control Limits

C-41:	D-Min	+/-0.03	+/-0.05
	LD	+/-0.06	+/-0.08
	HD-LD	+/-0.07	+/-0.09
	D-max B - YB	+/-0.10	+/-0.12
	D-max R - D-max G	-0.20	-0.25
RA-4:	D-min	N/A	+/-0.02
	LD	+/-0.07	+/-0.10
	HD-LD	+/-0.07	+/-0.10
	D-max (BP)	- 0.10	- 0.15

Running and plotting control strips

Consistency !

Frequency

Temperature of strip

Surface read on

Position on processor

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Running and plotting control strips

TEST-REFERENCE

Plotting :

Read the control strip.

Calculate the difference between the aim values and the control strip density readings.

Plot the difference on the Y-55 form.

Control strip density readings greater than the aim values will plot above the base line.

Control strip density readings less than the aim values will plot below the base line.

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Running and plotting control strips

Plots exceed the action limits. What should be done ?

Run another strip to confirm that a problem really exists.

If the second test confirms that a problem does exist, determine the possible causes. Remember the four basics :

- T TEMPERATURE
- A AGITATION/CIRCULATION
- R REPLENISHMENT (CHEMICAL STRENGTH)
- T TIME

After the problem is corrected, run another test to confirm that the processor is in control.

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RA-4 Control Strip Readings

	R	G	B
D-max (BP)	____	____	____
HD	____	____	____
LD	____	____	____
Contrast (HD-LD)	____	____	____
D-min	____	____	____

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C-41 Control Strip Readings

	R	G	B
D-max	___	___	___
HD	___	___	___
LD	___	___	___
Contrast (HD-LD)	___	___	___
D-min	___	___	___
Yellow B			___
Retained Silver, D-max B - YB			___
Leuco Cyan, D-max R - D-max G			___

(May Require Bleach Monitoring Strip)

Mixing Chemicals

Safety First

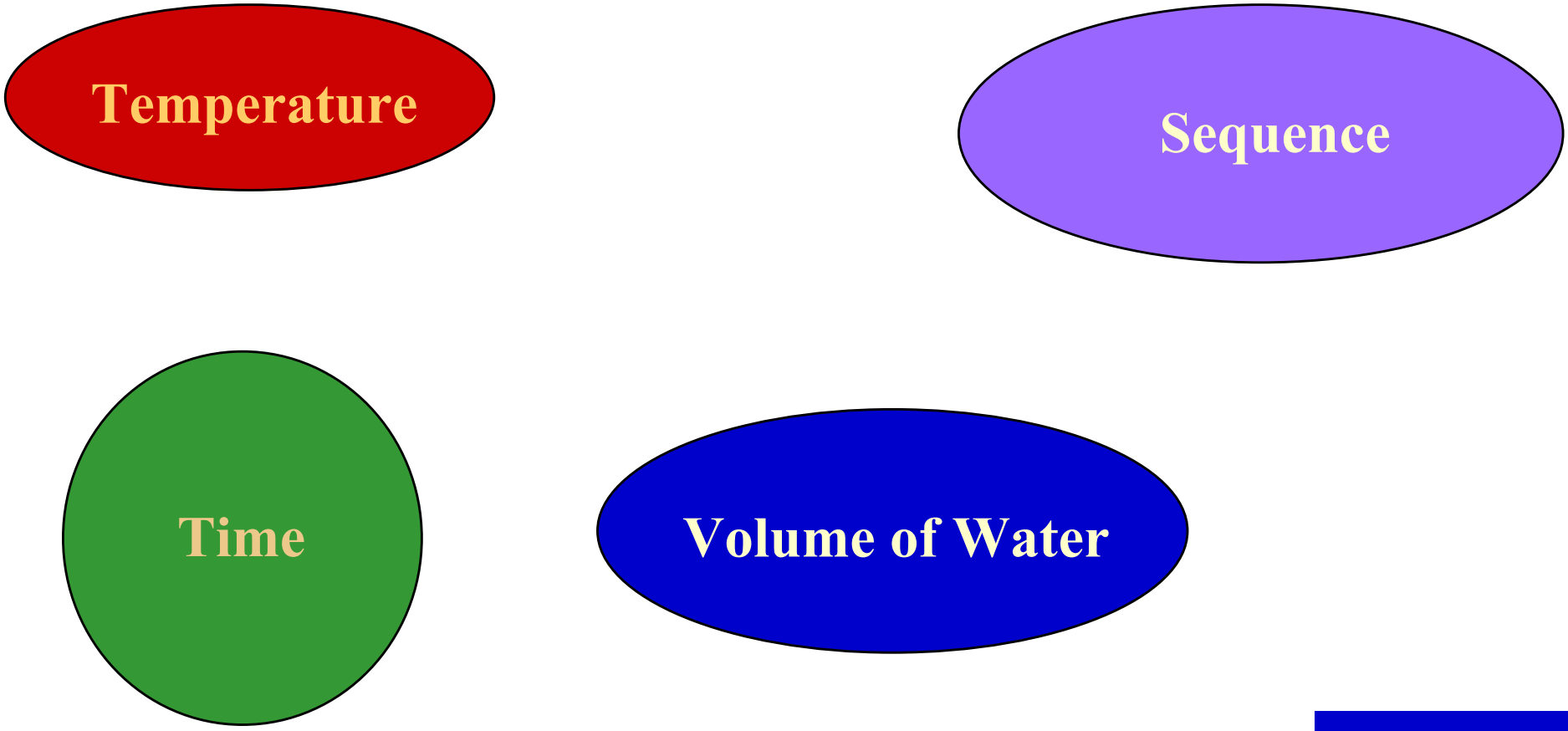
Wear protective clothing : Goggles, apron, gloves.

Mix in a well ventilated area.

For additional information regarding the chemistry, see the MSDS.

Mixing Chemicals

Follow the specific instructions given by the manufacturer.



Mixing Chemicals

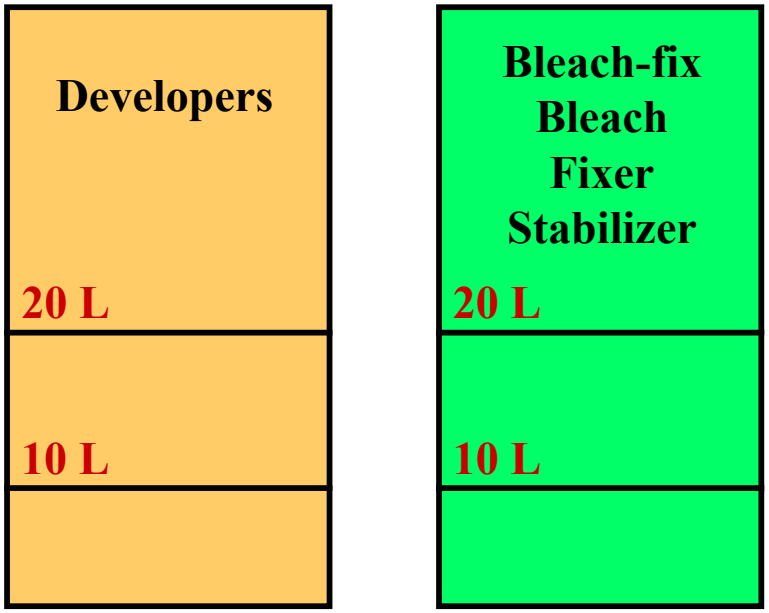
Mix Tanks

Are they properly calibrated ?

Use a separate tank for developers and a separate tank for all other secondaries.

Never assume the mix tank is clean.

Always rinse the mix tank before and after use.



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Mixing Chemicals

Was it mixed properly ?

Does the color and overall appearance look right ?

Is the specific gravity within specification ?

Too high - not enough water or extra parts added .

Too low - too much water or parts not added.

Is the pH within specification ?

Too high or too low - too many parts added or parts missing.

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Mixing Chemicals

Working Tank Solution:

A fresh working tank solution is required when;

1) A processor is being used for the first time.

2) Severe process control problems occur and the chemicals must be dumped to remedy the situation.

RA-4 Developer:	**Water**
	Developer replenisher
	Starter
RA-4 Bleach-fix:	**Bleach-fix replenisher**
	(water)
C-41 Developer:	**Water**
	Developer replenisher
	Starter
C-41 Bleach:	**Water**
	Bleach replenisher
	Starter
C-41 Fixer:	**(Water)**
	Fixer replenisher
C-41 Stabilizer:	**(Water)**
	Stabilizer replenisher

Calculating Replenishment Rates

Recommended replenishment rates are starting points.

The actual replenishment rates will depend on the :

- **rate of oxidation**
- **percent utilisation**
- **type of processor**
- **type of paper or film**

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Calculating Replenishment Rates

Replenishment rates are usually given in mL/ft² or mL/m².

This is the amount chemistry that needs to be replenished after processing 1 square foot of paper/film or 1 square meter of paper/film, respectively.

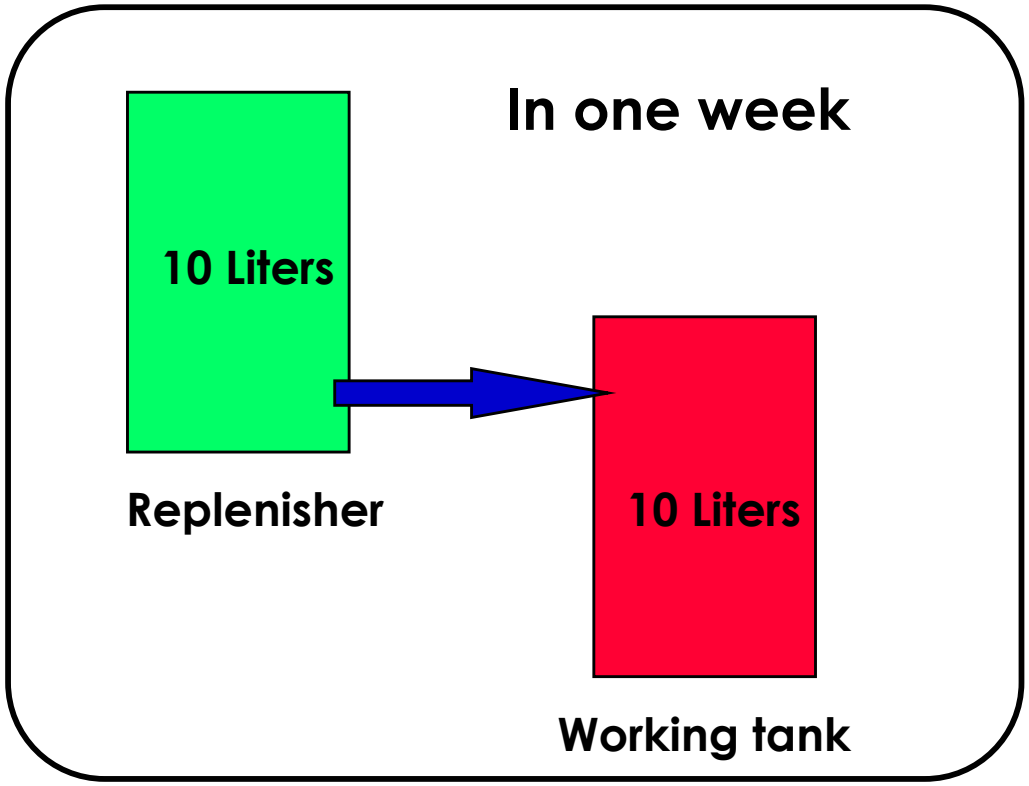
On most processors, the replenishment rate is converted to mL/minute or mL/replenishment cycle.

This is done by calculating the total square feet/meters of paper or film processed in one minute or in one replenishment cycle.

Calculating Replenishment Rates

Utilisation

For optimum results, tank turn over must be considered. CPAC recommends the consumption of at least one processor tank volume of fresh replenisher on a weekly basis.



Trouble Shooting C-41 Developer

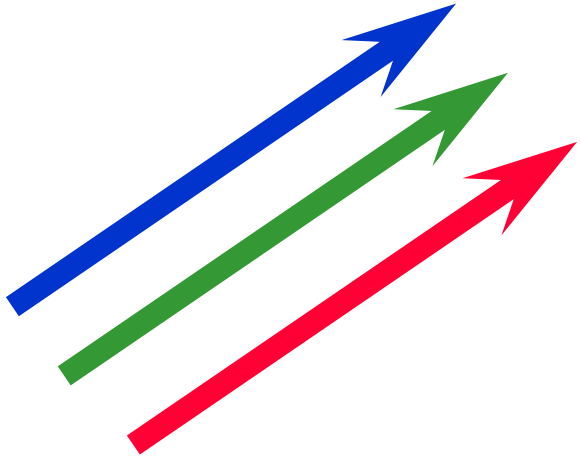
In General:
As developer activity increases the process control plots will increase.

The primary purpose of the developer is:

To form a dye image by

converting color

couplers with ODA



Increased activity is a result of:

T - Increased Temperature
A - Increased Agitation
R - Increased Replenishment
T - Increased Time
Not Enough Starter

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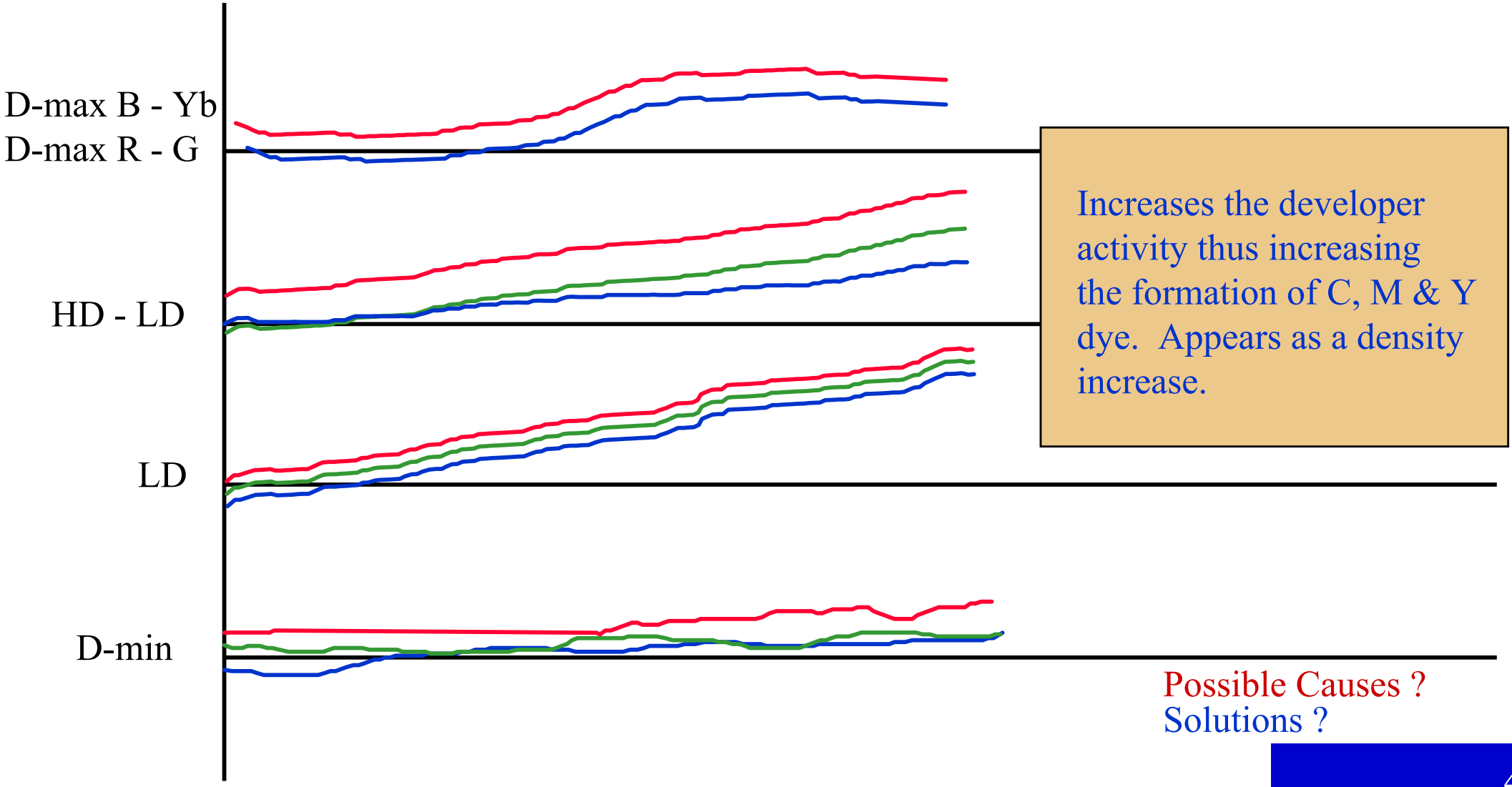
C-41 Developer
Temperature High / Replenishment High / Time Long



Increases the developer activity thus increasing the formation of C, M & Y dye. Appears as a density increase.

Possible Causes ?
Solutions ?

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C-41 Developer
Temperature High / Replenishment High / Time Long

Possible Causes ?

- Temperature set wrong.
- Temperature control not calibrated and/or malfunctioning.
- Replenishment rate set too high.
- Significant increase in production.
- Replenishment system not calibrated.
- Replenishment system is passing chemistry during non-replenishment modes.
- Lane switch/sensor is stuck.
- Machine is not properly timed.
- Cine machine is not properly threaded.
- Poor tank circulation

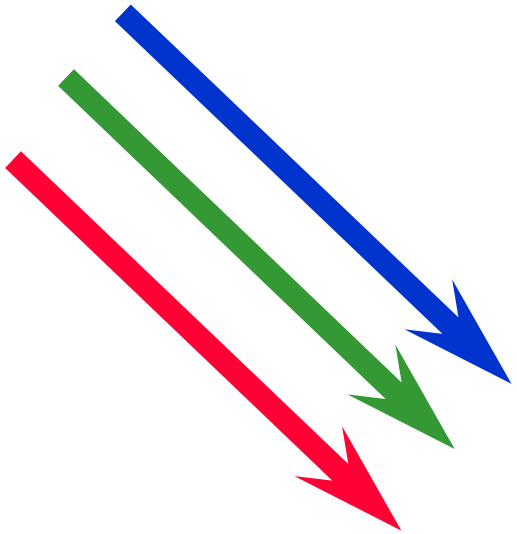
Solutions !

- Make necessary corrections/repairs as to eliminate cause.

Trouble Shooting C-41 Developer

In General:

As developer activity decreases the process control plots will decline.



Decreased activity is a result of:

T - Decreased Temperature

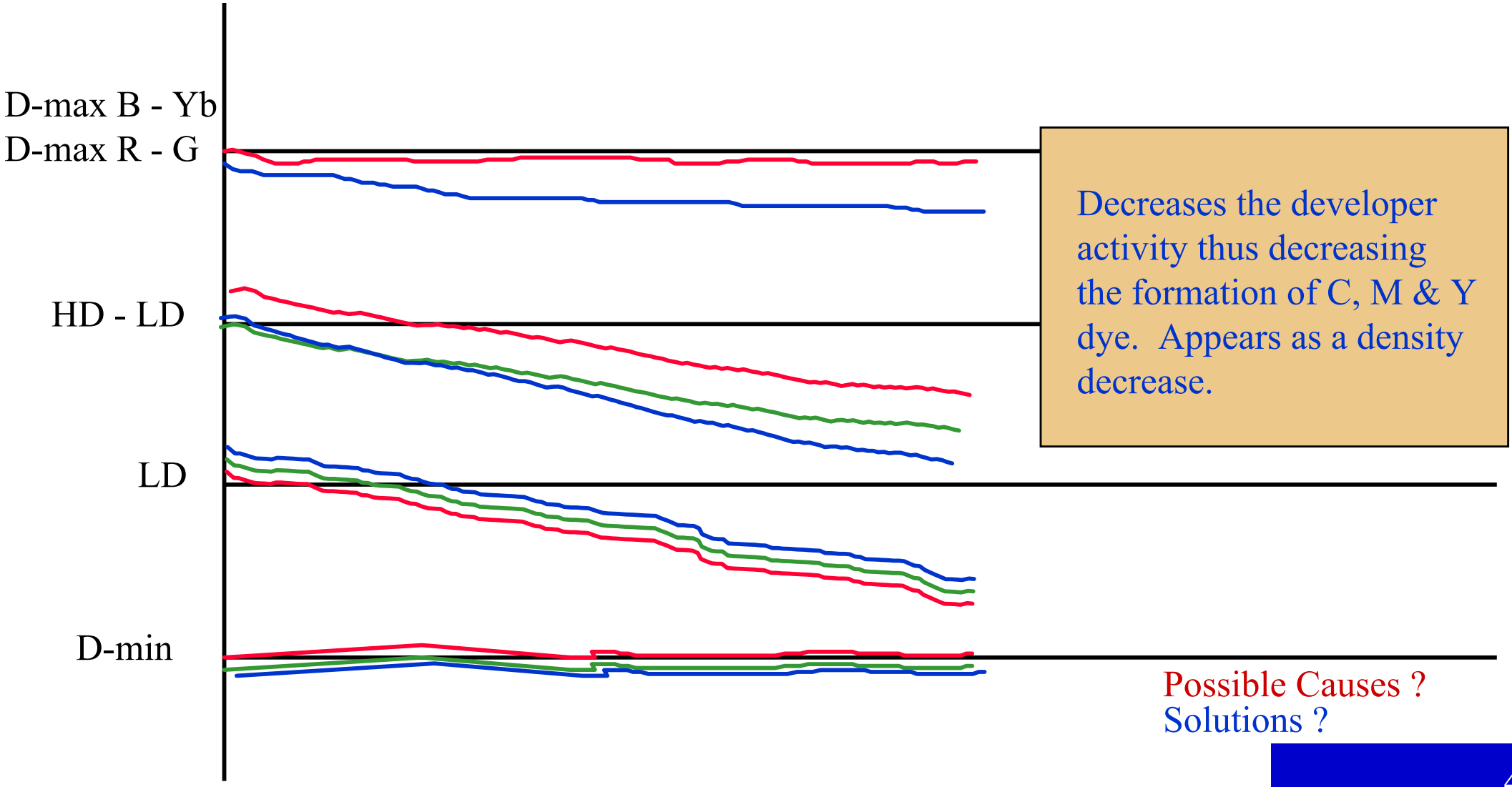
A - Decreased Agitation

R - Decreased Replenishment

T - Decreased Time

Too Much Starter

C-41 Developer
Temperature Low / Replenishment Low / Time Short



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C-41 Developer
Temperature Low / Replenishment Low / Time Short

Possible Causes ?

- Temperature set wrong.
- Temperature control not calibrated and/or malfunctioning.
- Replenishment rate set too low.
- Significant decrease in production.
- Replenishment system not calibrated.
- Replenishment system is not replenishing during replenishment modes.
- Lane switch/sensor is not activated
- Machine is not properly timed.
- Cine machine is not properly threaded.
- Poor tank circulation.

Solutions !

- Make necessary corrections/repairs as to eliminate cause.

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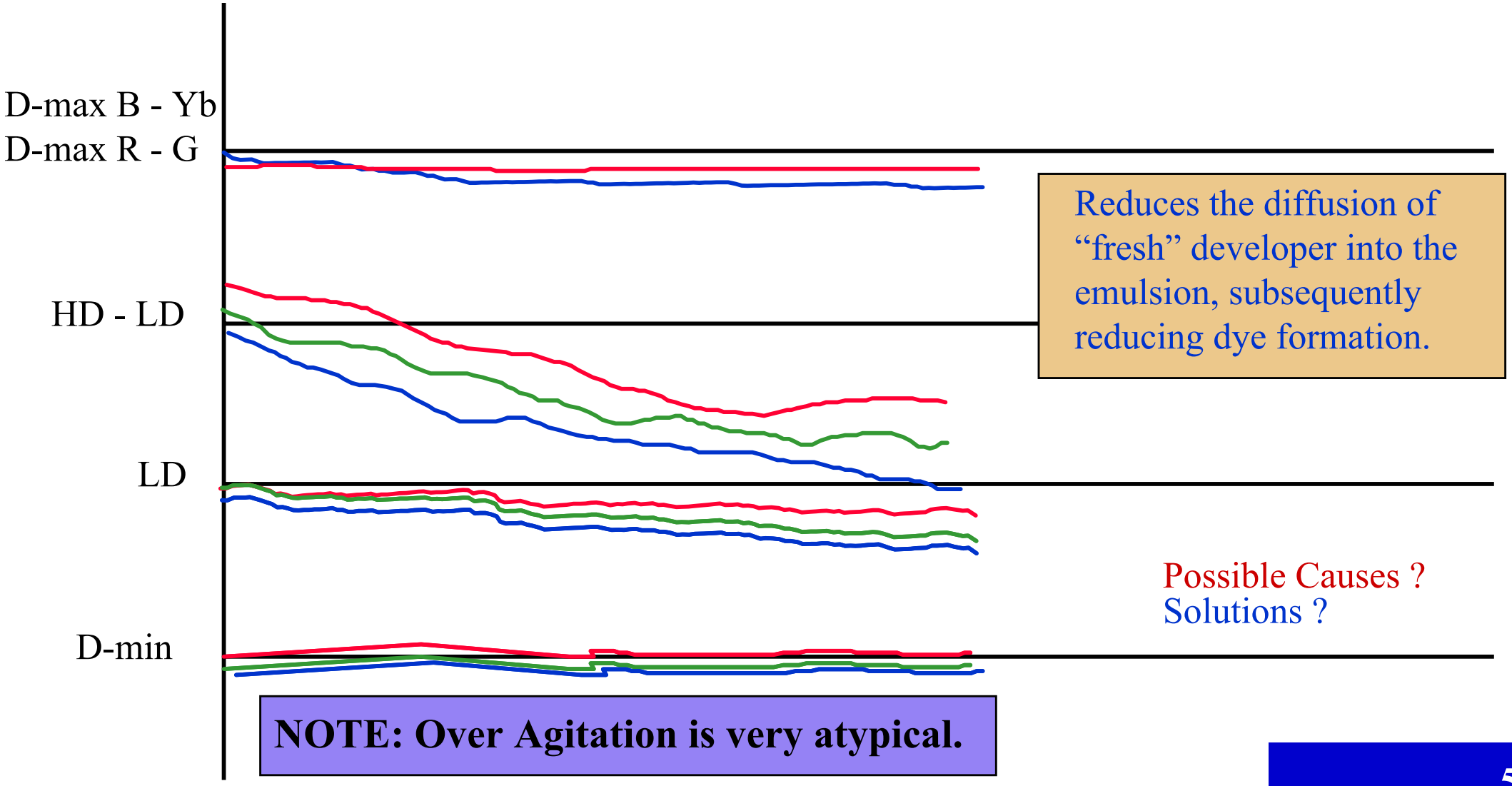
C-41 Developer - Poor Agitation



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C-41 Developer - Poor Agitation

Possible Causes ?

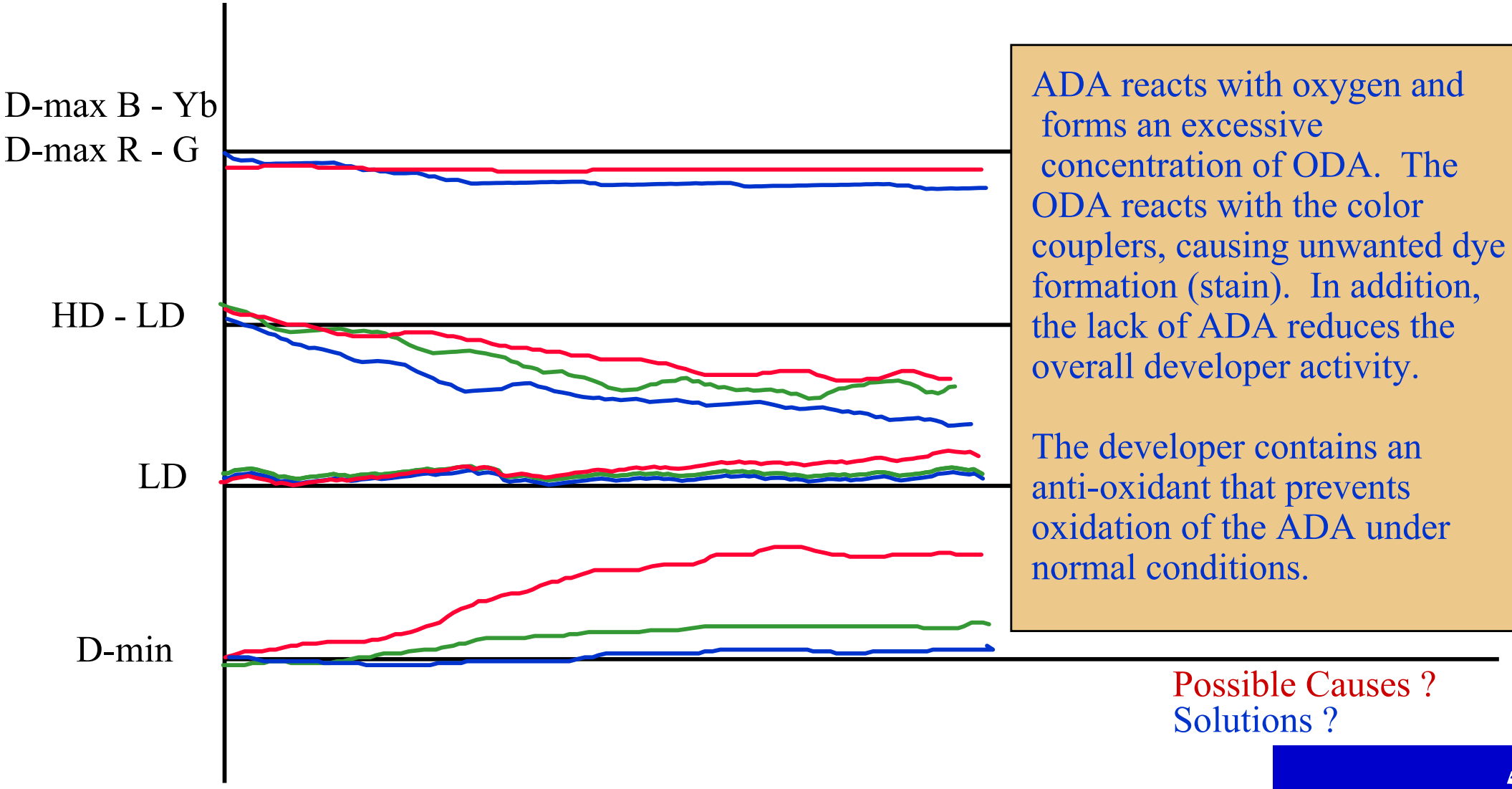
- **Filter is clogged.**
- **Turbulator bar is clogged.**
- **Motor is not working.**
- **Pump impeller is clogged.**

Solutions !

- Make necessary corrections/repairs as to eliminate cause.

cpac Imaging

C-41 Developer - Oxidised



ADA reacts with oxygen and forms an excessive concentration of ODA. The ODA reacts with the color couplers, causing unwanted dye formation (stain). In addition, the lack of ADA reduces the overall developer activity.

The developer contains an anti-oxidant that prevents oxidation of the ADA under normal conditions.

Possible Causes ?
Solutions ?

C-41 Developer - Oxidised

Possible Causes ?

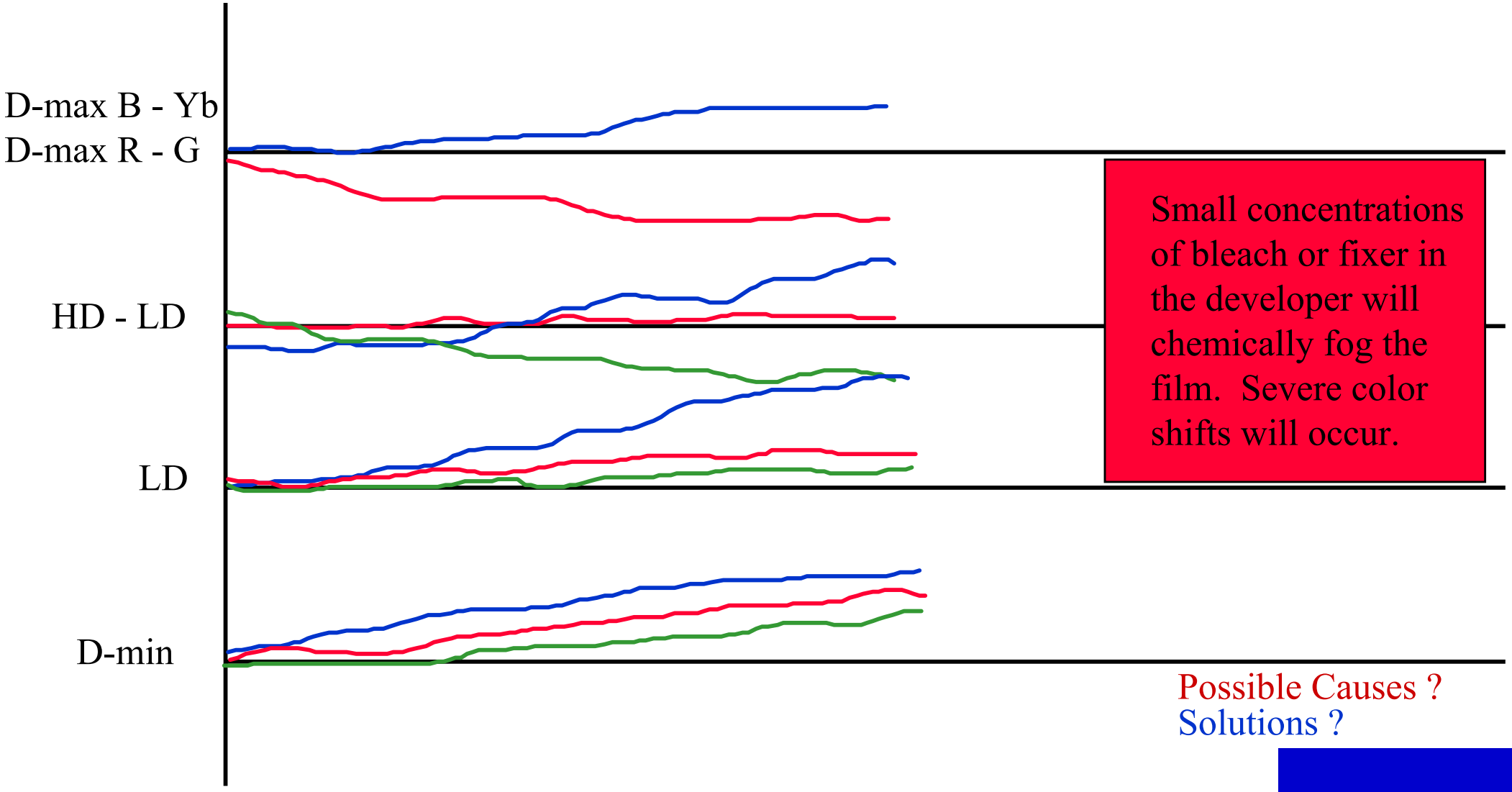
- **Low utilization.**
- **Mechanical aeration from a leak in the circulation system.**
- **Air used for agitation.**

Solutions !

- Go to a higher rate material or force tank turnover.
- Make necessary corrections/repairs as to eliminate cause.
- Use nitrogen for agitation.

cpac Imaging

C-41 Developer - Contaminated with Bleach or Fixer



Small concentrations of bleach or fixer in the developer will chemically fog the film. Severe color shifts will occur.

Possible Causes ?
Solutions ?

C-41 Developer - Contaminated with Bleach or Fixer

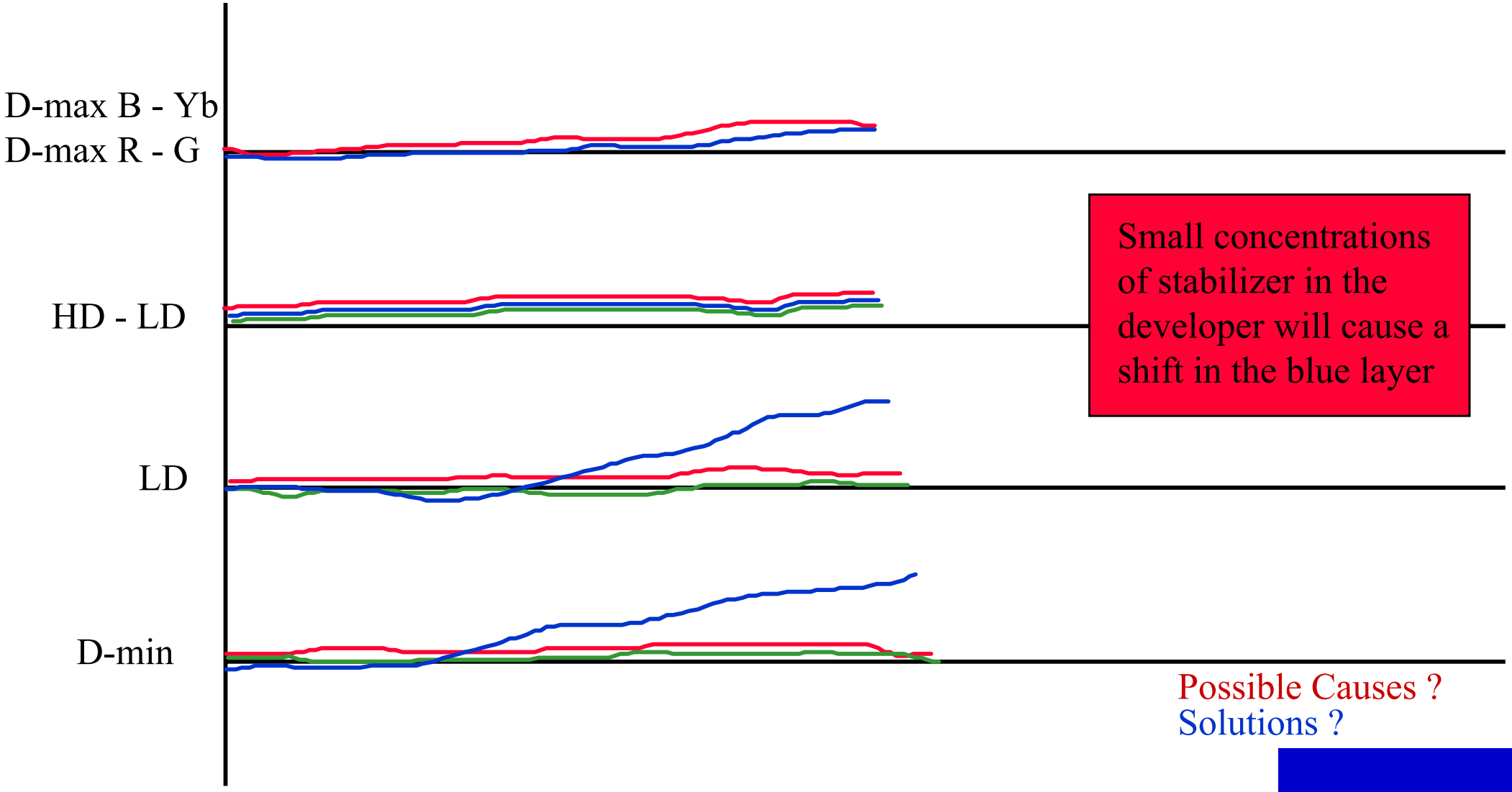
Possible Causes ?

- **Splash back during general maintenance.**
- **Mix error.**
- **Poor exhaust resulting in high concentration of chemical fumes.**
- **Aggressive aeration of bleach.**
- **Leader with iron staples.**

Solutions !

- Make necessary corrections/repairs as to eliminate cause.

C-41 Developer - Contaminated with Stabilizer



C-41 Developer - Contaminated with Stabilizer

Possible Causes ?

- **Mix error.**
- **Residual stabilizer on leader cards not rinsed off.**

Solutions !

- Make necessary corrections/repairs as to eliminate cause.
- Use new leader cards.

Trouble Shooting C-41 Bleach

In General:
The primary C-41 bleach variables are:

Replenishment

Aeration

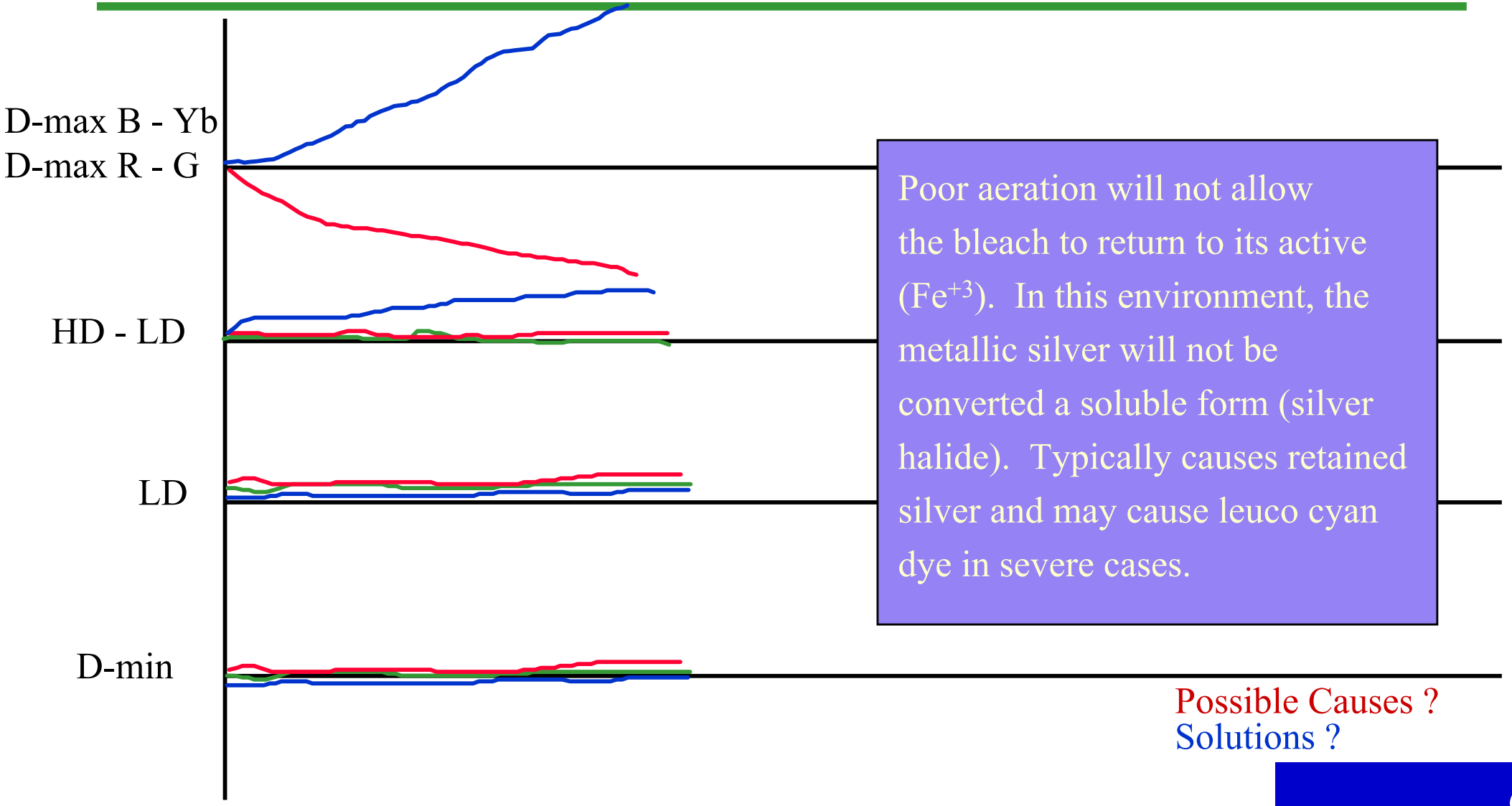
Time

pH

The primary purpose of the bleach is:

To stop the development process and
to convert metallic silver into soluble silver.

C-41 Bleach - Poor Aeration



Poor aeration will not allow the bleach to return to its active (Fe^{+3}). In this environment, the metallic silver will not be converted a soluble form (silver halide). Typically causes retained silver and may cause leuco cyan dye in severe cases.

Possible Causes ?
Solutions ?

C-41 Bleach - Poor Aeration

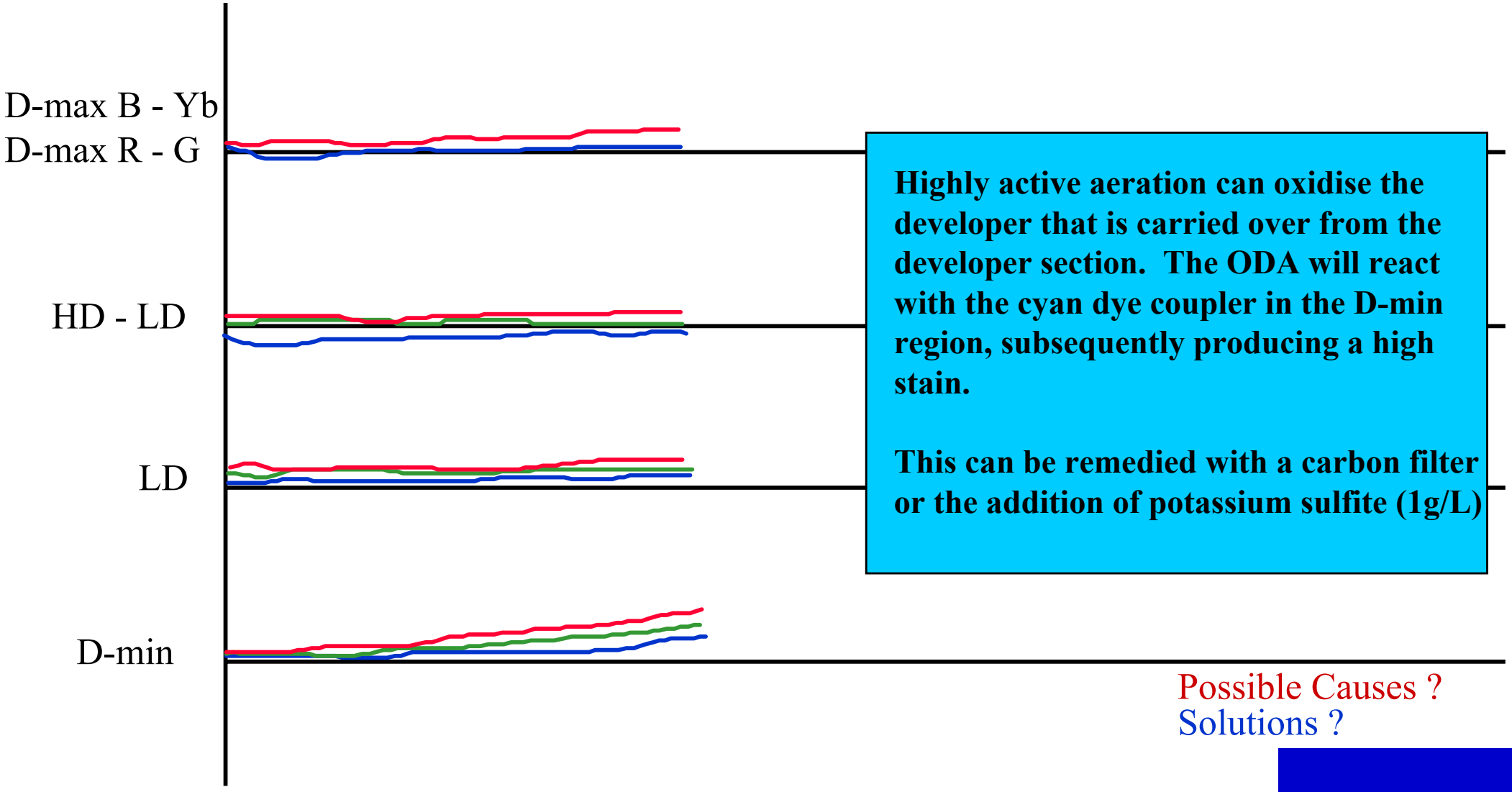
Possible Causes ?

- **Aeration unit not operating or defective.**
- **Aeration unit does not exist.**

Solutions !

- Make necessary corrections/repairs as to eliminate cause.

C-41 Bleach - Excessive Developer Carry-in



Highly active aeration can oxidise the developer that is carried over from the developer section. The ODA will react with the cyan dye coupler in the D-min region, subsequently producing a high stain.

This can be remedied with a carbon filter or the addition of potassium sulfite (1g/L)

Possible Causes ?
Solutions ?

C-41 Bleach - Excessive Developer Carry-in

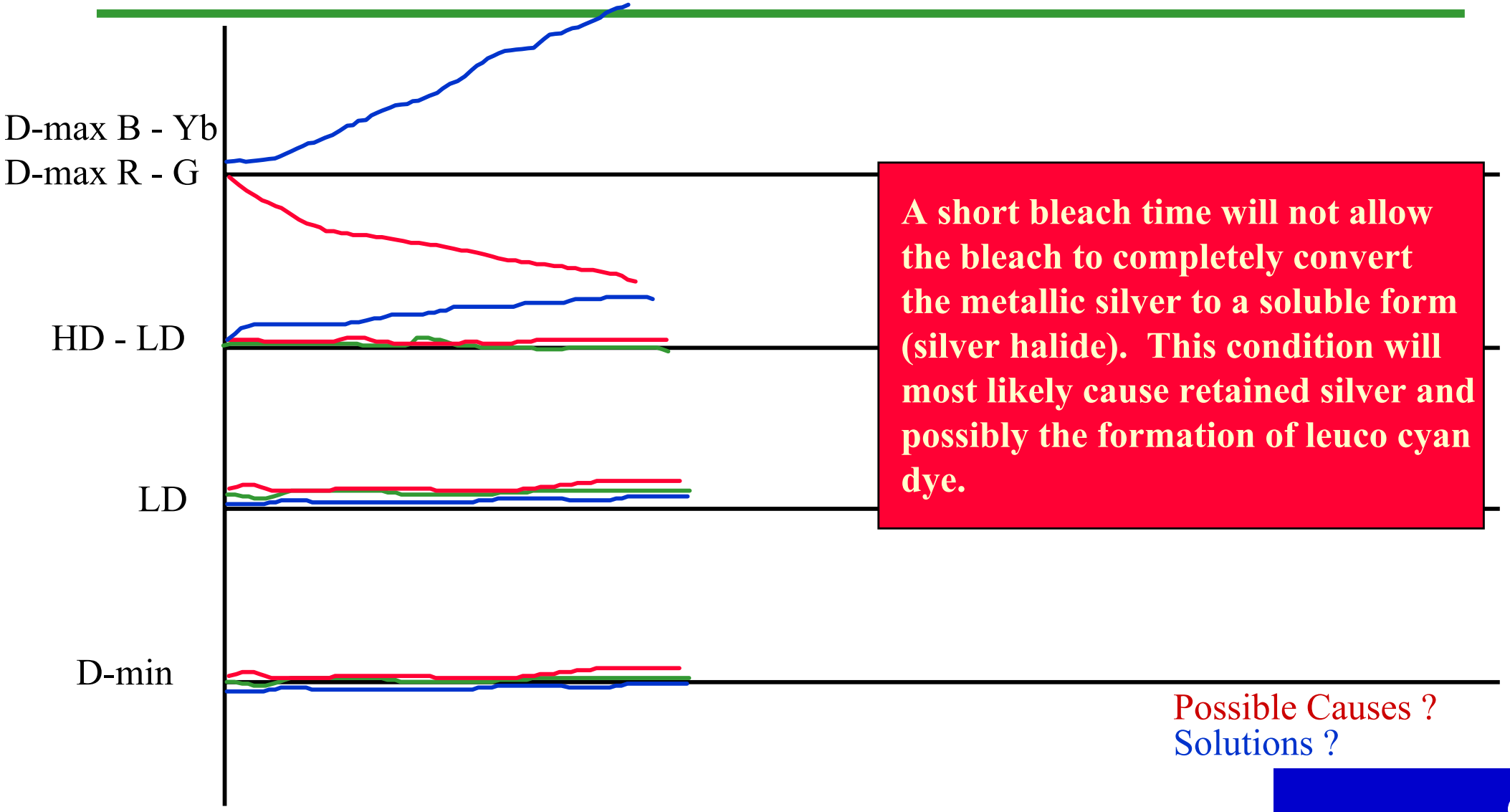
Possible Causes ?

- **Poor developer exit squeegees.**

Solutions !

- Make necessary corrections/repairs as to eliminate cause.
- Add potassium sulfite to tie up ODA.
- Treat regenerated bleach with a carbon filter.

C-41 Bleach - Short Time



A short bleach time will not allow the bleach to completely convert the metallic silver to a soluble form (silver halide). This condition will most likely cause retained silver and possibly the formation of leuco cyan dye.

Possible Causes ?
Solutions ?

C-41 Bleach - Short Time

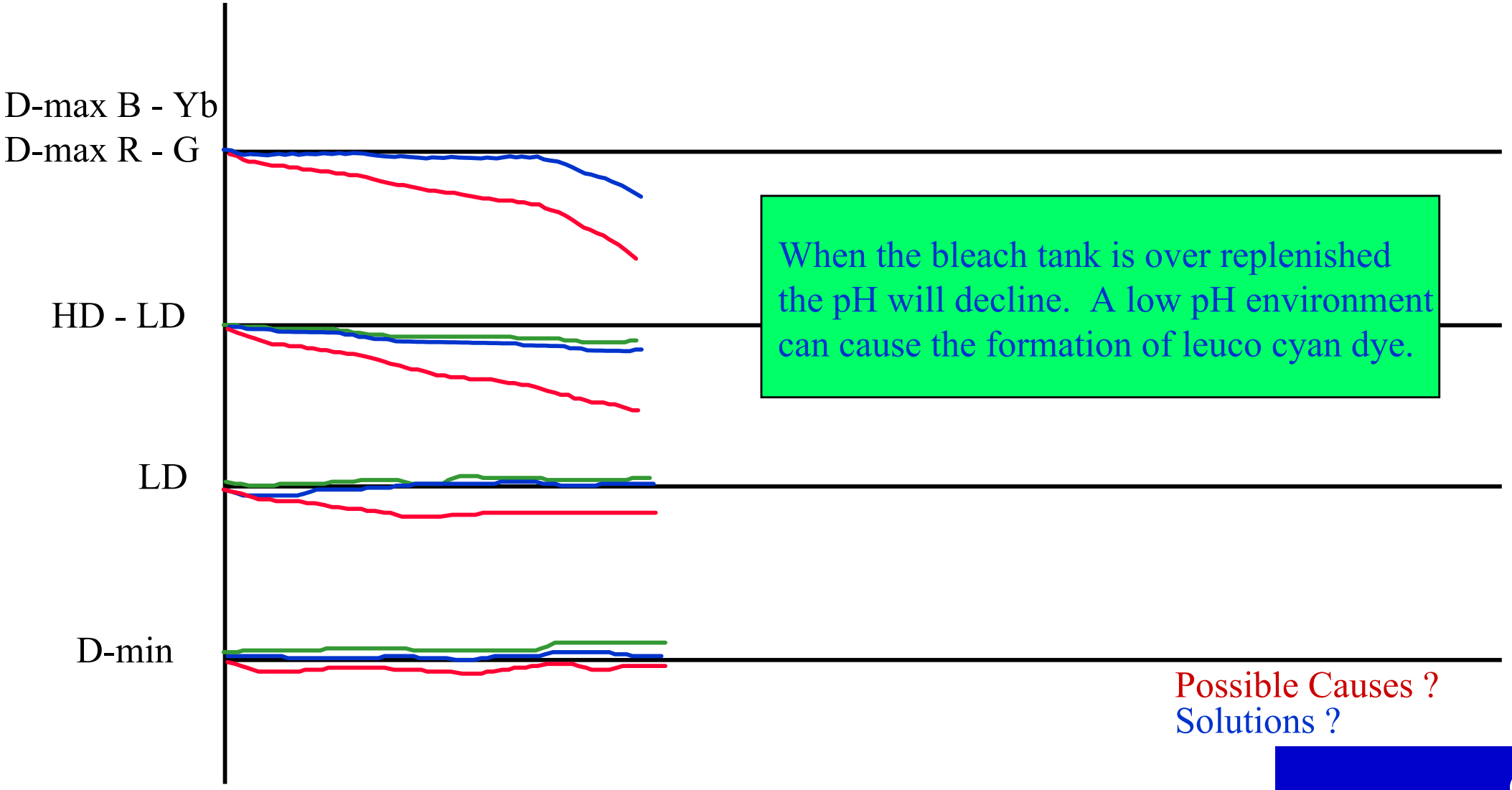
Possible Causes ?

- **Machine racks not properly threaded.**
- **Not likely on a minilab.**
- **Wrong bleach.**

Solutions !

- Make necessary corrections/repairs as to eliminate cause.
- Use correct bleach.

C-41 Bleach - High Replenishment Rate / Low pH



When the bleach tank is over replenished the pH will decline. A low pH environment can cause the formation of leuco cyan dye.

Possible Causes ?
Solutions ?

C-41 Bleach - High Replenishment Rate / Low pH

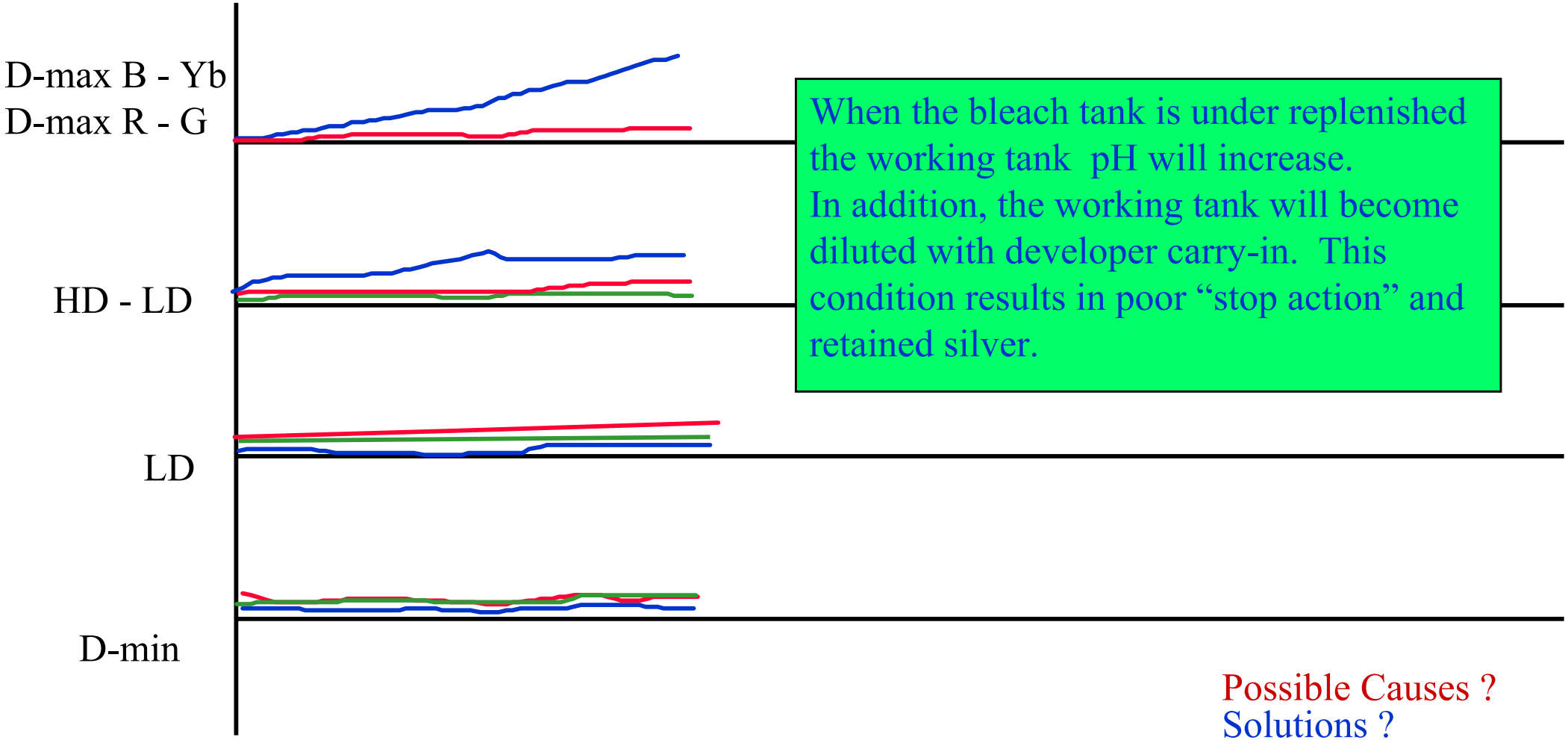
Possible Causes ?

- **Replenishment rate set too high.**
- **Replenishment system not calibrated.**
- **Replenishment system is passing chemistry during non-replenishment modes.**
- **Lane switch/sensor is activated at all times.**
- **Wrong mixing.**

Solutions !

- Make necessary corrections/repairs as to eliminate cause.

C-41 Bleach - Low Replenishment Rate / High pH



When the bleach tank is under replenished the working tank pH will increase.
In addition, the working tank will become diluted with developer carry-in. This condition results in poor "stop action" and retained silver.

Possible Causes ?
Solutions ?

C-41 Bleach - Low Replenishment Rate / High pH

Possible Causes ?

- **Replenishment rate set too low.**
- **Replenishment system not calibrated.**
- **Replenishment system is not replenishing during replenishment modes.**
- **Lane switch/sensor is not activated.**
- **Wrong mixing.**

Solutions !

- Make necessary corrections/repairs as to eliminate cause.

Trouble Shooting C-41 Fixer

In General:

The primary C-41 Fixer variables are:

The primary purpose of the fixer is:

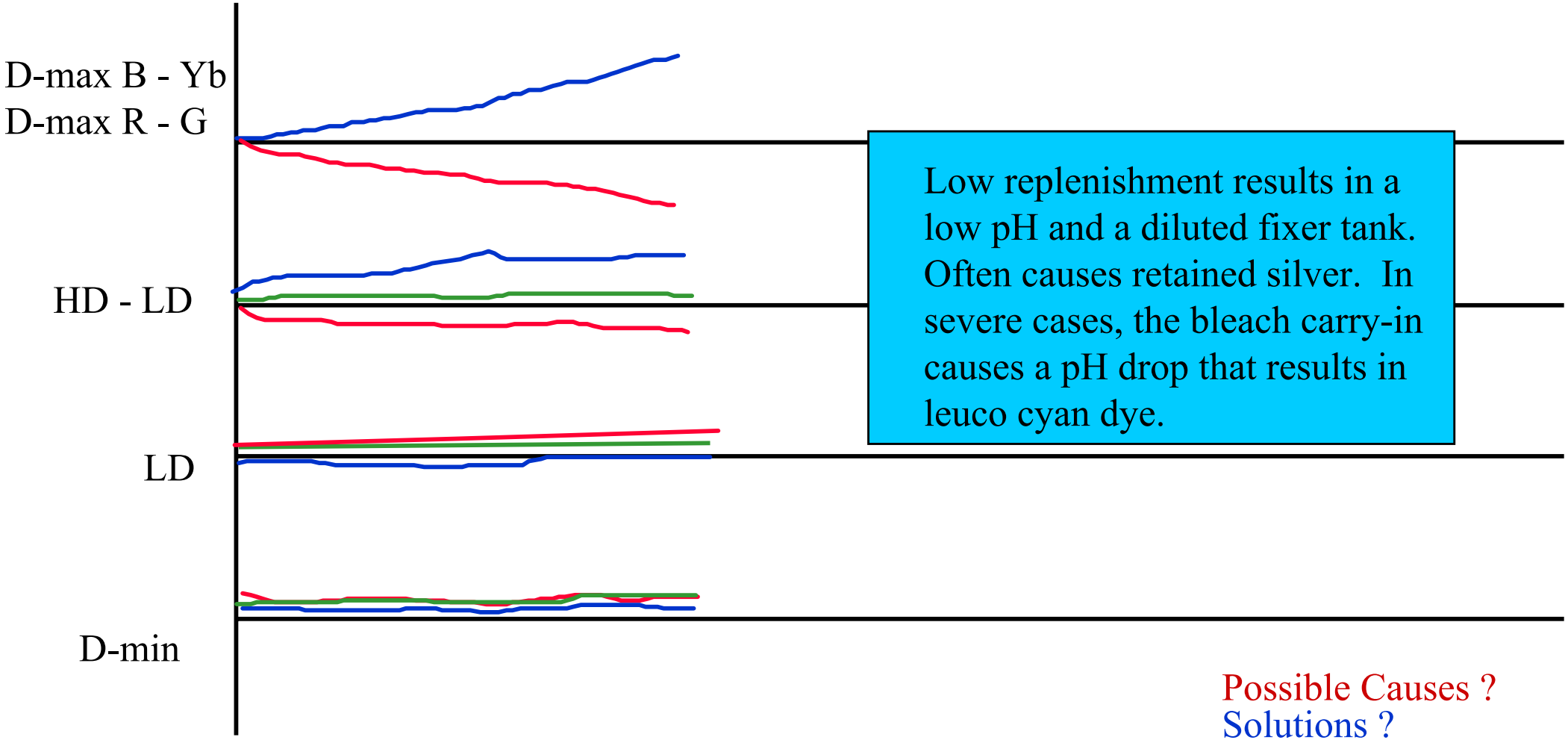
To complex with silver halide and remove it from the film.

Replenishment

Time

Oxidation

C-41 Fixer - Low Replenishment



Low replenishment results in a low pH and a diluted fixer tank. Often causes retained silver. In severe cases, the bleach carry-in causes a pH drop that results in leuco cyan dye.

Possible Causes ?
Solutions ?

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C-41 Fixer - Low Replenishment

Possible Causes ?

- **Replenishment rate set too low.**
- **Replenishment system not calibrated.**
- **Replenishment system is not replenishing during replenishment modes.**
- **Lane switch/sensor is not activated.**

Solutions !

- Make necessary corrections/repairs as to eliminate cause.

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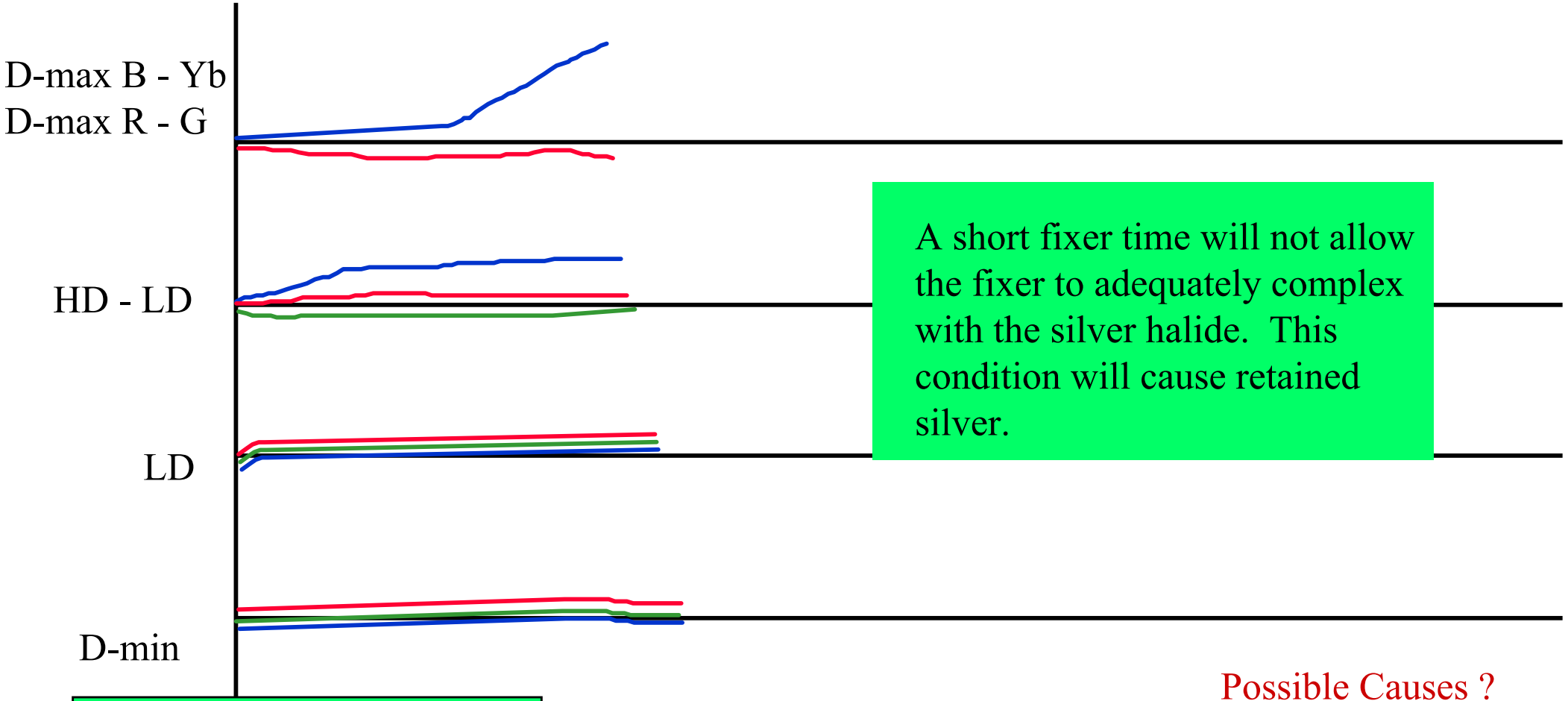
C-41 Fixer - Short Time



A short fixer time will not allow the fixer to adequately complex with the silver halide. This condition will cause retained silver.

A long time?
Typically not a problem with the exception of lost productivity.

Possible Causes ?
Solutions ?

C-41 Fixer - Short Time

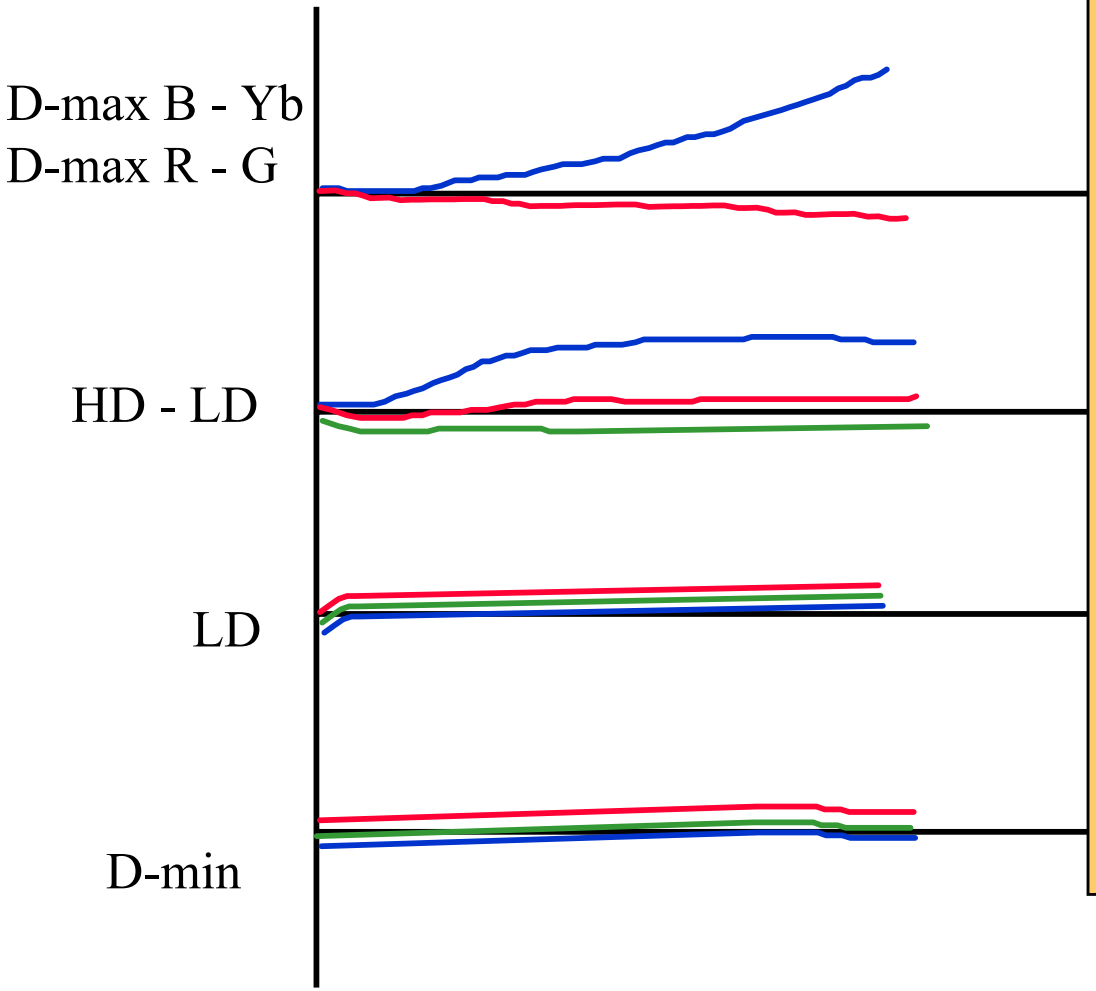
Possible Causes ?

- **Machine racks not properly threaded.**
- **Not likely on a minilab.**

Solutions !

- Make necessary corrections/repairs as to eliminate cause.

C-41 Bleach / Fixer Retained Silver



Retained silver can be confirmed by re-bleaching and/or re-fixing the control strip.

Step #1: Re-fix the control strip.

First re-fix, rinse and dry the control strip.

If there is a significant sensitometric change, a less than optimum fixer condition exists.

If there is no sensitometric change, go to step#2

Step#2: Re-bleach and re-fix the control strip.

Re-bleach, re-fix, rinse and dry the control strip.

If there is a significant sensitometric change, a less than optimum bleach condition exists.

If there is no sensitometric change, a retained silver condition does not exist.

Possible Causes ?
Solutions ?

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C-41 Bleach / Fixer Retained Silver

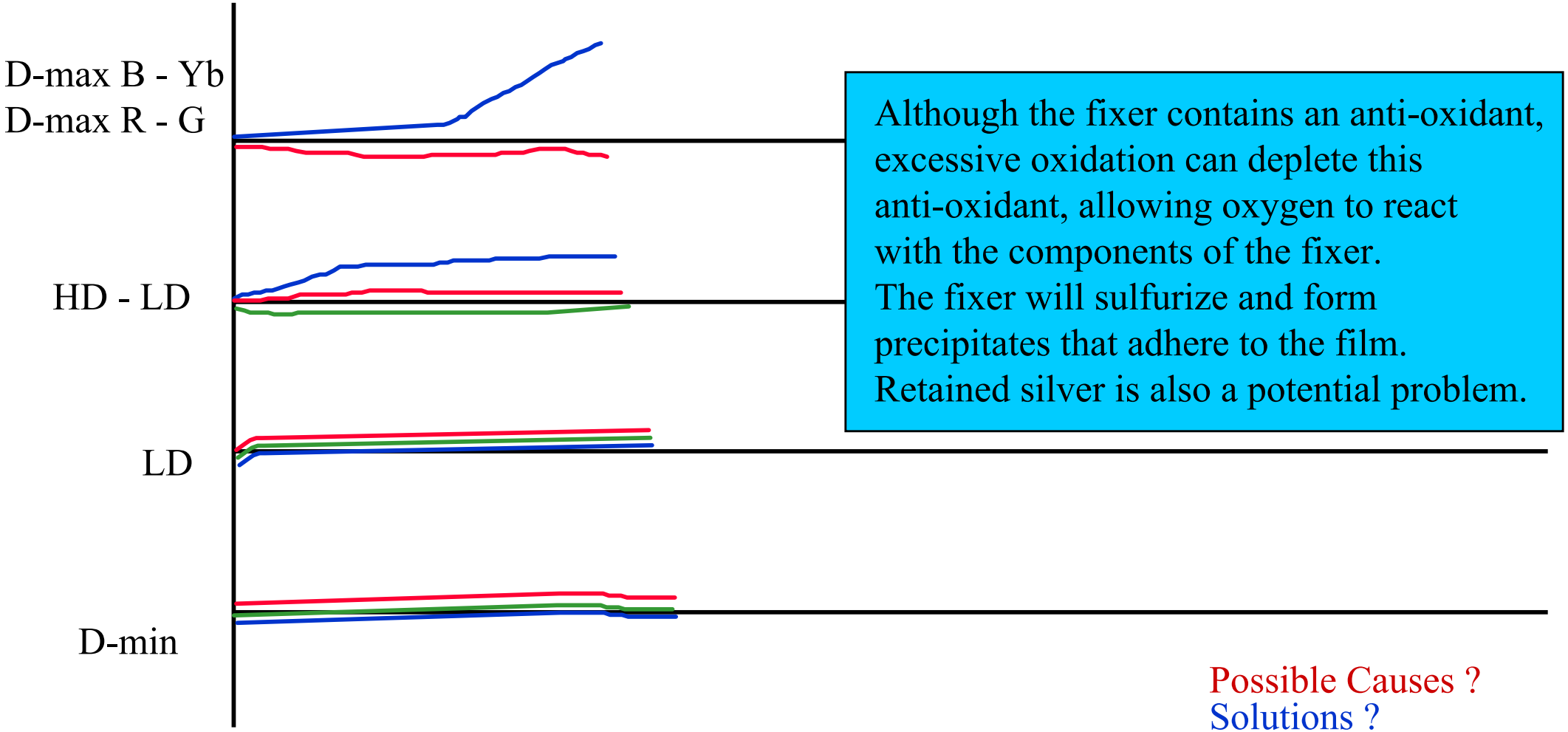
Possible Causes ?

- **Poor or no bleach aeration.**
- **Dilute/weak bleach.**
- **Dilute/weak fixer.**
- **Temperature set too low on bleach or fixer.**

Solutions !

- Make necessary corrections/repairs as to eliminate cause.
- See previous info on bleach and fixer.

C-41 Fixer - Oxidised



Although the fixer contains an anti-oxidant, excessive oxidation can deplete this anti-oxidant, allowing oxygen to react with the components of the fixer.
The fixer will sulfurize and form precipitates that adhere to the film.
Retained silver is also a potential problem.

Possible Causes ?
Solutions ?

C-41 Fixer - Oxidised

Possible Causes ?

- **Low utilization.**
- **Oxidiation of the fixer because of airleak in the circulation system.**

Solutions !

- Replace working tank solution.
- Make necessary corrections/repairs as to eliminate cause.

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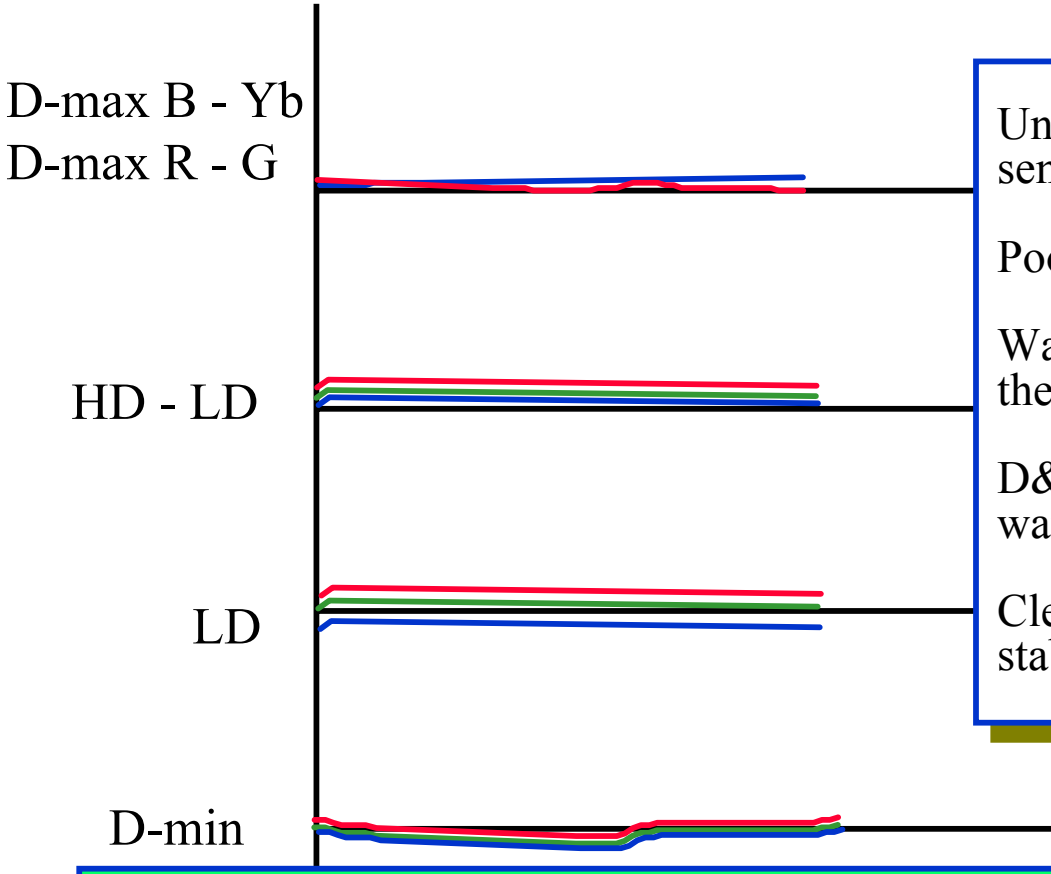
Trouble Shooting C-41 Stabilizer



Under normal conditions, stabilizer does not have a sensitometric effect.

Poor stabilization may result in accelerated dye degradation.

Washless processors require ML or ELF stabilizer to prevent the formation of white precipitates that adhere to the film.

D&D processors can not use ELF stabilizer because of water spotting.

Clean fresh stabilizer is essential. Many labs replace their stabilizer on a weekly basis.

The primary purpose of the stabilizer is:

To stabilize the dye image and to harden the emulsion.

Possible Causes ?
Solutions ?

Trouble Shooting C-41 Stabilizer

Possible problems:

- **Stabilizer is under replenished.**
- **Not changed frequently enough.**
- **Stabilizer has a bad smell (rotten eggs).**

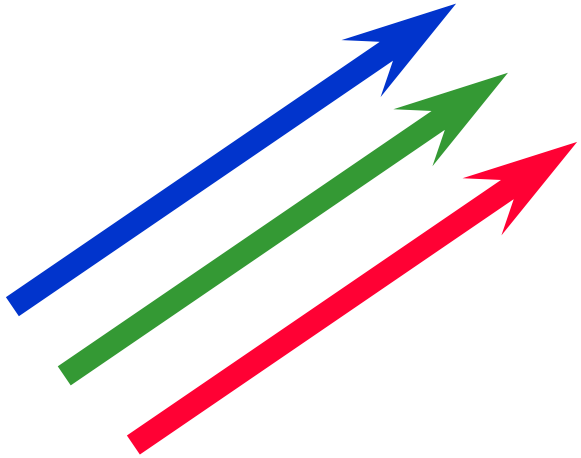
Solutions !

- Increase replenishment rate.
- Replace stabilizer more often.
- Add anti-algae product to stabilizer replenisher tank.

Trouble Shooting RA Developer

In General:

As developer activity increases the process control plots will increase.



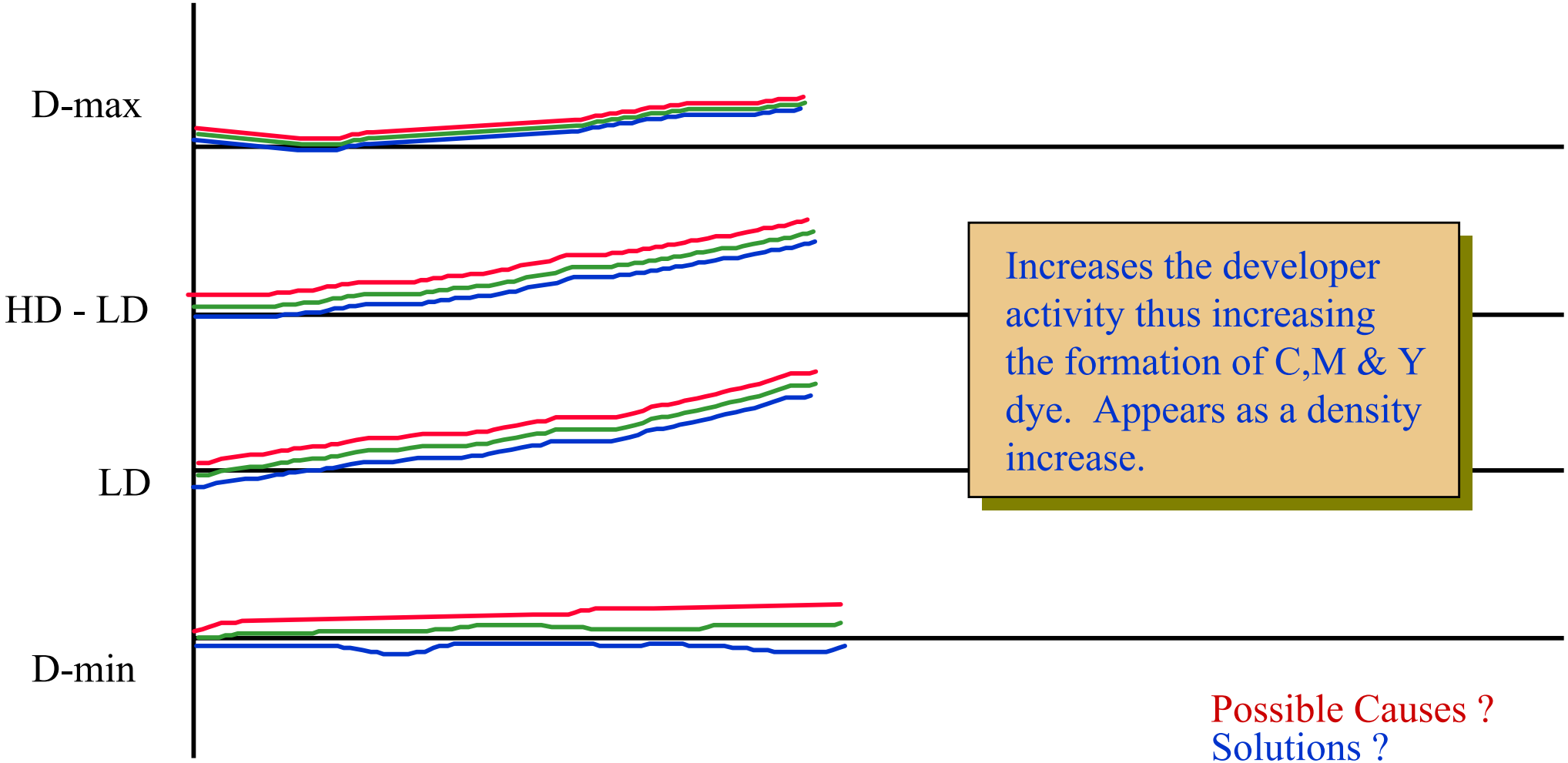
The primary purpose of the developer is:

To form a dye image by converting color couplers with ODA and convert silver halide to metallic silver.

Increased activity is a result of:

T - Increased Temperature
A - Increased Agitation
R - Increased Replenishment
T - Increased Time
Not Enough Starter

RA Developer
Temperature High / Replenishment High / Time Long



Increases the developer activity thus increasing the formation of C,M & Y dye. Appears as a density increase.

Possible Causes ?
Solutions ?

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RA Developer
Temperature High / Replenishment High / Time Long

Possible Causes ?

- Temperature set wrong.
- Temperature control not calibrated and/or malfunctioning.
- Replenishment rate set too high.
- Significant increase in production.
- Replenishment system not calibrated.
- Replenishment system is passing chemistry during non-replenishment modes.
- Lane switch/sensor is stuck.
- Machine is not properly timed.

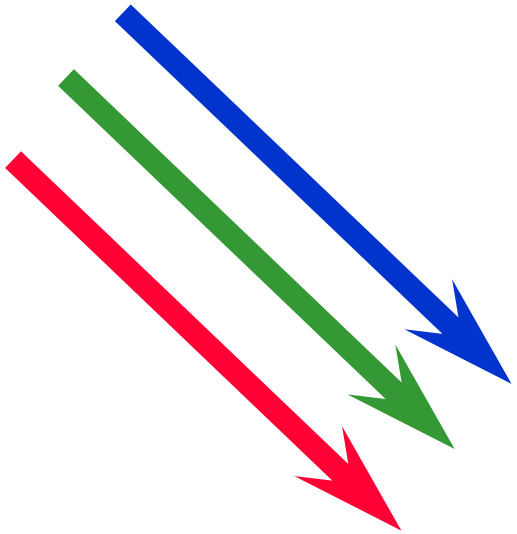
Solutions !

- Make necessary corrections/repairs as to eliminate cause.

Trouble Shooting RA Developer

In General:

As developer activity decreases the process control plots will decline.



Decreased activity is a result of:

T - Decreased Temperature

A - Decreased Agitation

R - Decreased Replenishment

T - Decreased Time

Too Much Starter

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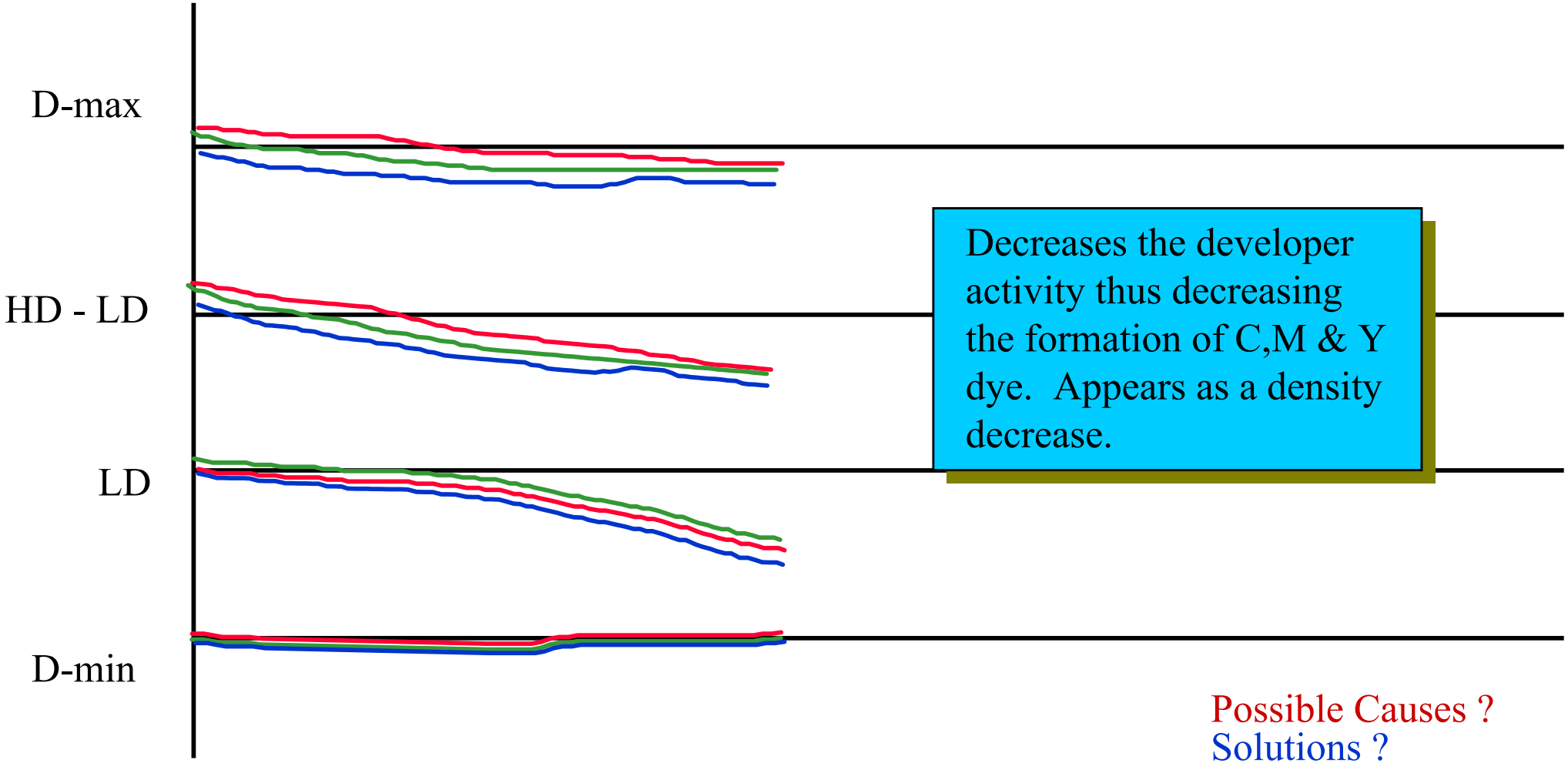
RA Developer
Temperature Low / Replenishment Low / Time Short



Decreases the developer activity thus decreasing the formation of C,M & Y dye. Appears as a density decrease.

Possible Causes ?
Solutions ?

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RA Developer
Temperature Low / Replenishment Low / Time Short

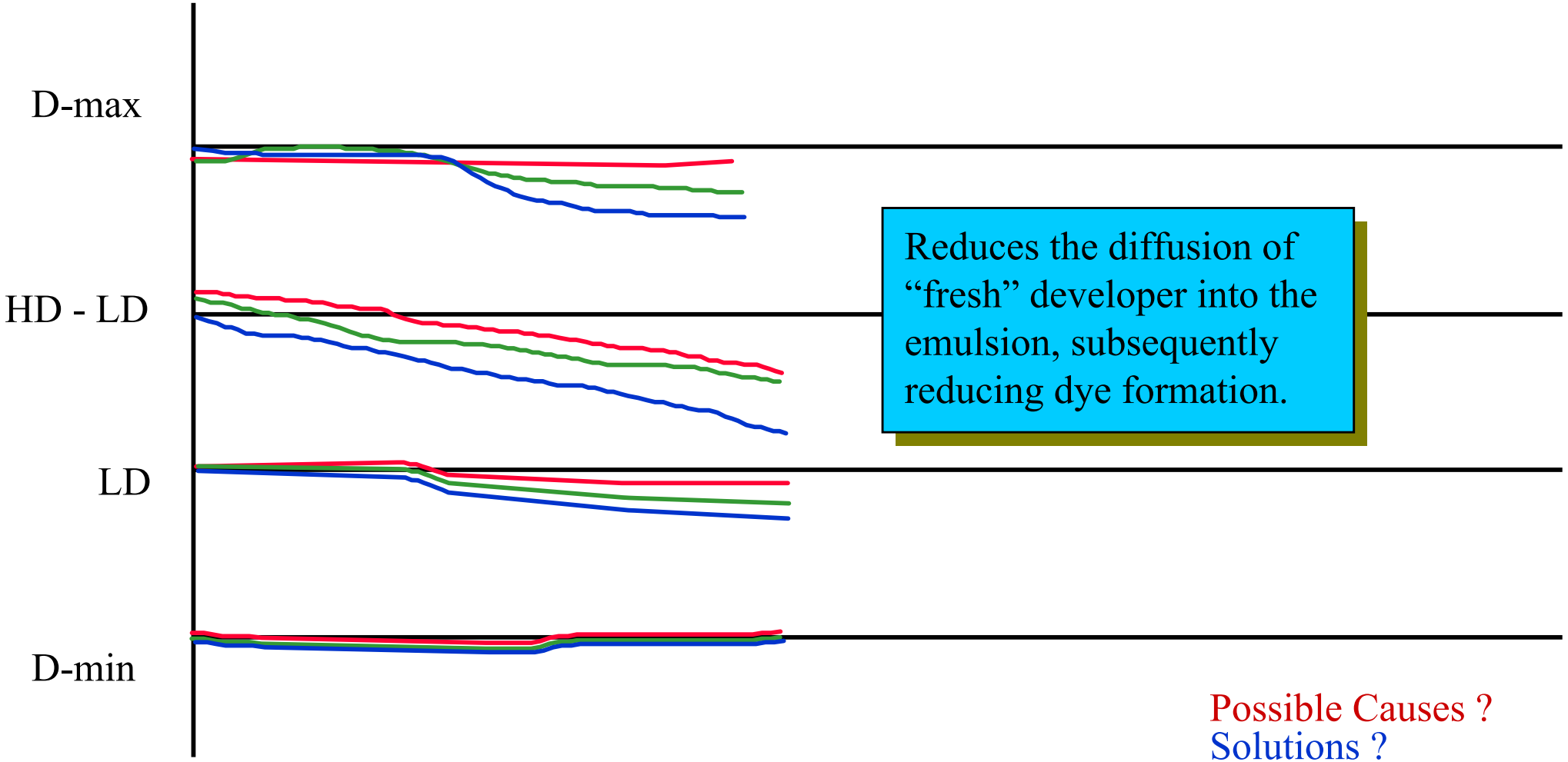
Possible Causes ?

- Temperature set wrong.
- Temperature control not calibrated and/or malfunctioning.
- Replenishment rate set too low.
- Significant decrease in production.
- Replenishment system not calibrated.
- Replenishment system is not replenishing during replenishment modes.
- Lane switch/sensor is not activated.
- Machine is not properly timed.

Solutions !

- Make necessary corrections/repairs as to eliminate cause.

RA Developer - Poor Agitation



Reduces the diffusion of "fresh" developer into the emulsion, subsequently reducing dye formation.

Possible Causes ?
Solutions ?

Note: Over agitation is very atypical.

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RA Developer - Poor Agitation

Possible Causes ?

- **Filter is clogged.**
- **Turbulator bar is clogged.**
- **Pump motor is not working.**
- **Pump impeller is clogged.**

Solutions !

- Make necessary corrections/repairs as to eliminate cause.

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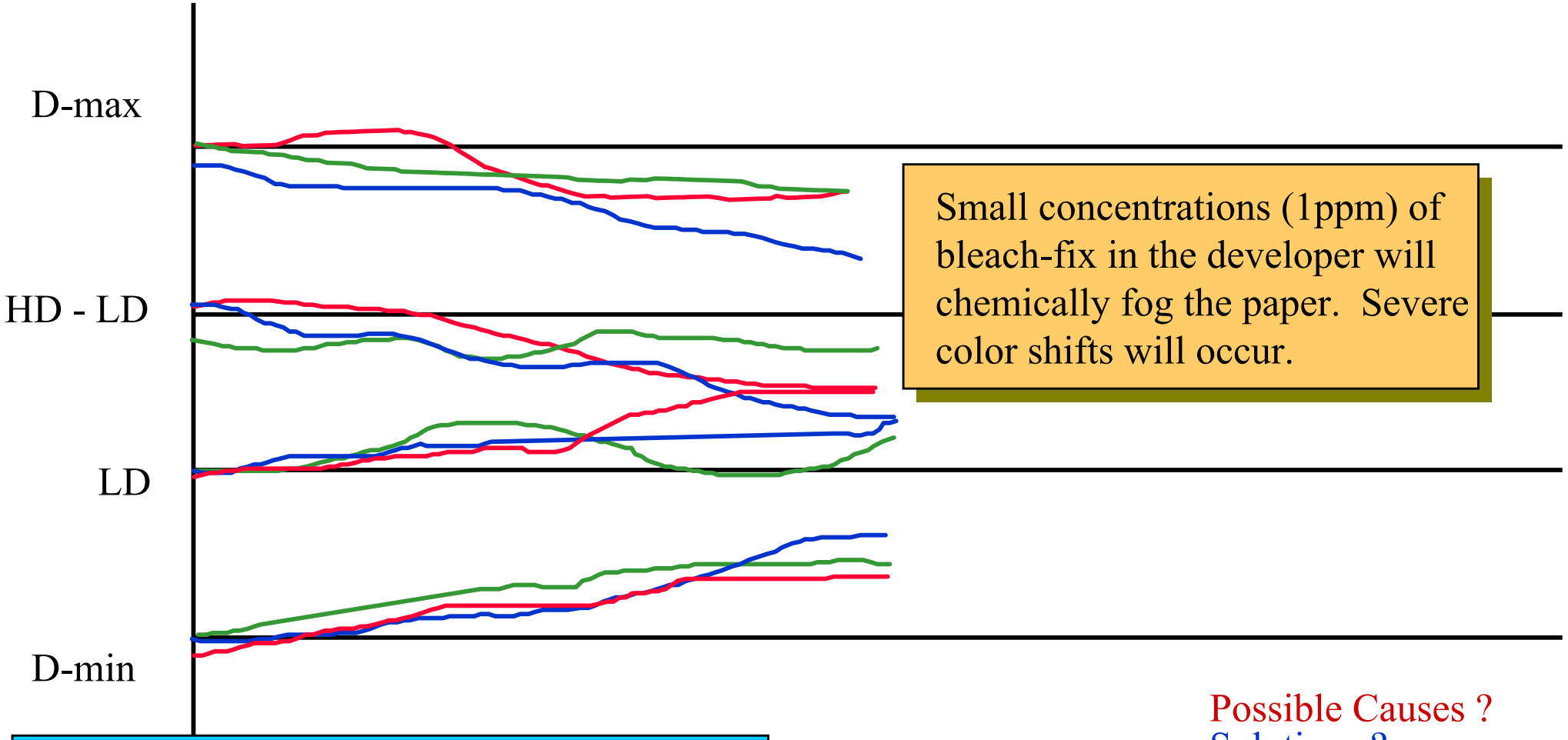
RA Developer - Contaminated with Bleach-Fix



Small concentrations (1ppm) of bleach-fix in the developer will chemically fog the paper. Severe color shifts will occur.

Possible Causes ?
Solutions ?

Note: Improperly exhausted ammonia fumes can emulate a bleach-fix problem.

RA Developer - Contaminated with Bleach-Fix

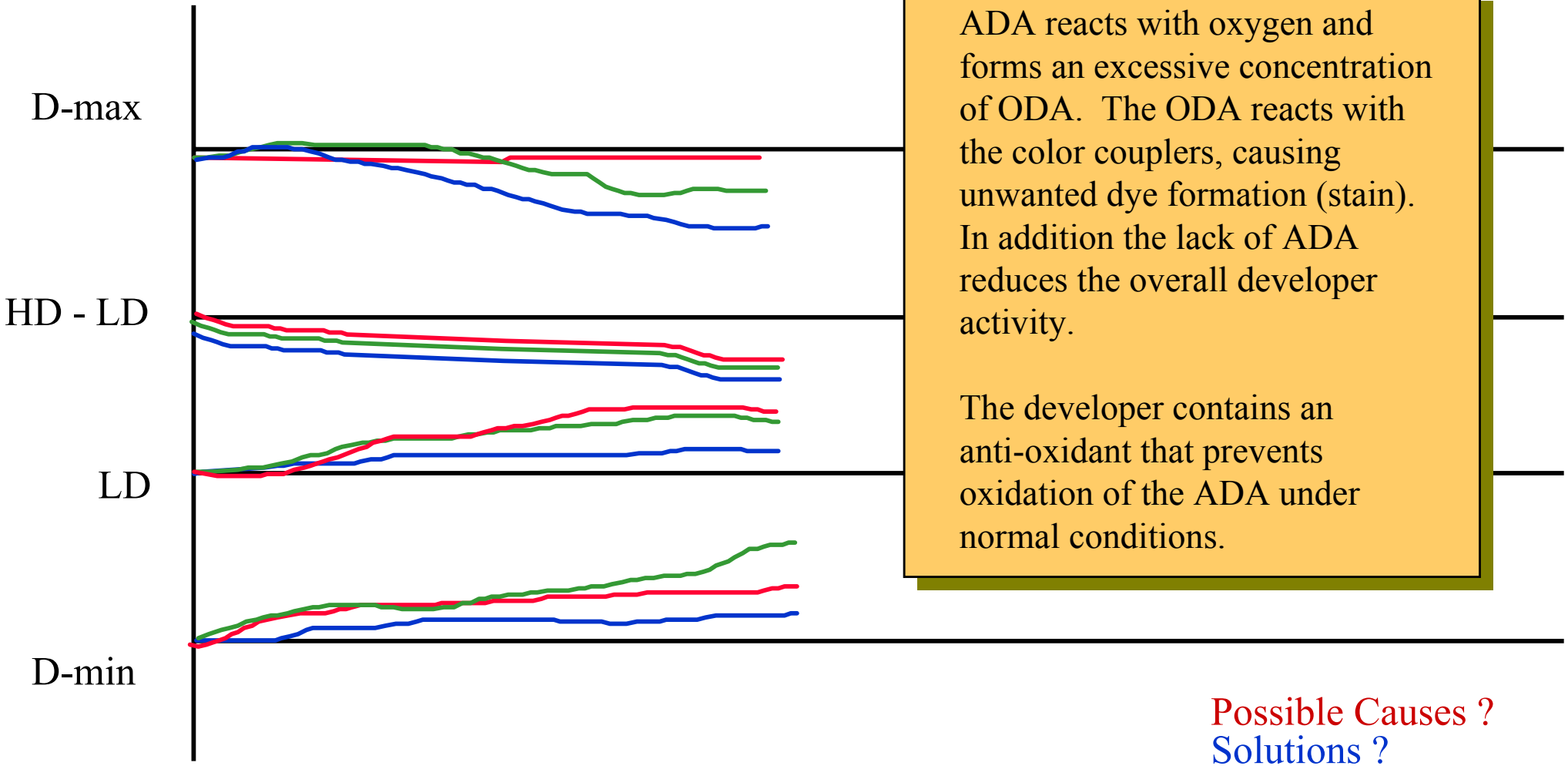
Possible Causes ?

- Splash back during general maintenance.
- Mix error.
- Poor exhaust resulting in high concentration of chemical fumes.
- Paper tail flipping bleach-fix back into the developer.

Solutions !

- Make necessary corrections/repairs as to eliminate cause.

RA Developer - Oxidised



ADA reacts with oxygen and forms an excessive concentration of ODA. The ODA reacts with the color couplers, causing unwanted dye formation (stain). In addition the lack of ADA reduces the overall developer activity.

The developer contains an anti-oxidant that prevents oxidation of the ADA under normal conditions.

Possible Causes ?
Solutions ?

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RA Developer - Oxidised

Possible Causes ?

- **Low utilization.**
- **Oxidiation of the developer because of airleak in the circulation system.**

Solutions !

- Switch to RA-RT developer and/ or use a developer additive to reduce oxidation.
- Make necessary corrections/repairs as to eliminate cause.

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Trouble Shooting RA Bleach-Fix

In General:

The primary RA bleach-fix variable are:

Replenishment

Time

pH

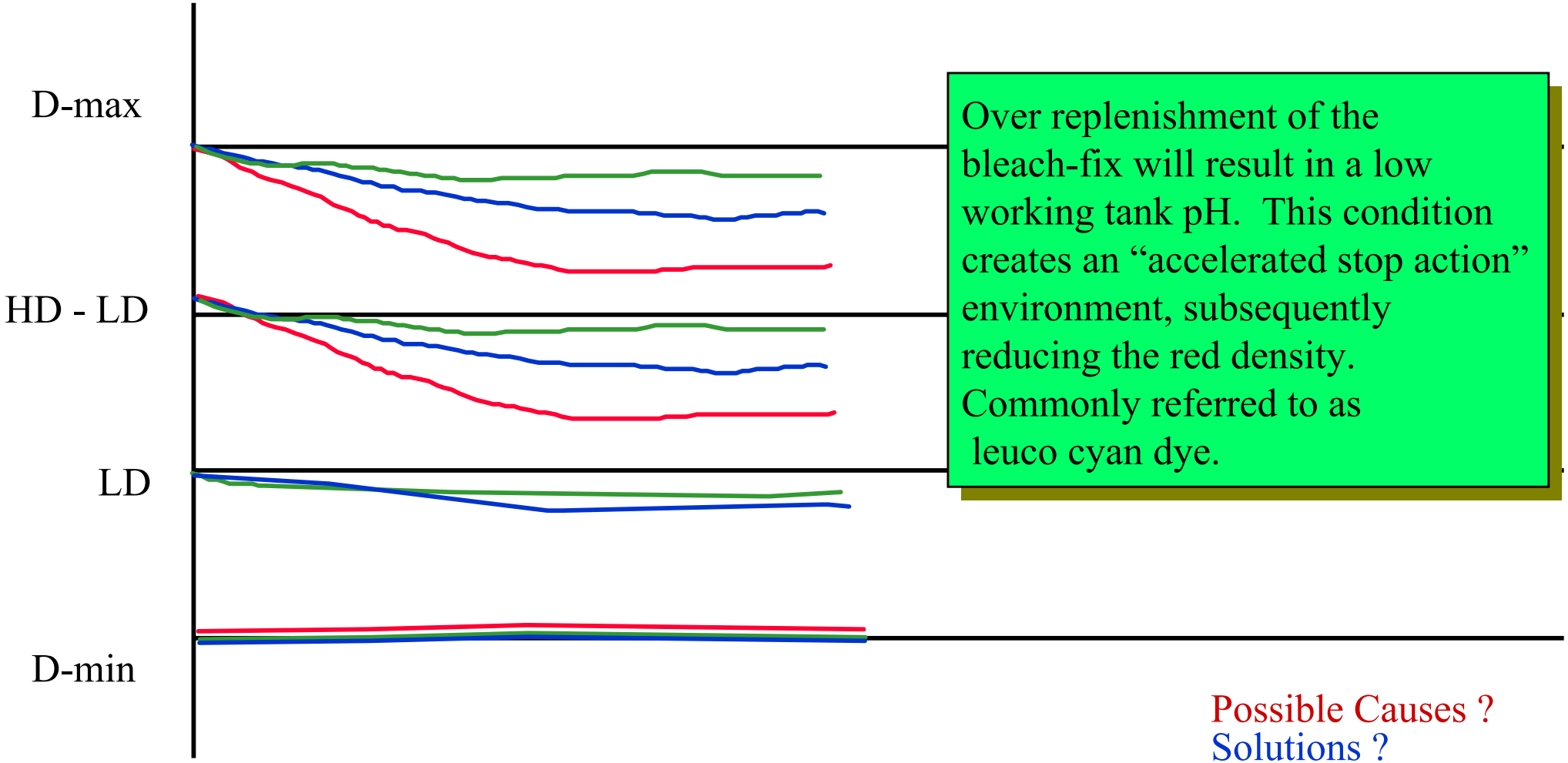
Oxidation

The primary purpose of the bleach-fix is:

A) To stop the development process.

B) 1. Convert metallic silver back to silver halide.
2. Complex with the silver halide and remove it from the paper.

RA Bleach-Fix - High Replenishment / Low pH



Over replenishment of the bleach-fix will result in a low working tank pH. This condition creates an "accelerated stop action" environment, subsequently reducing the red density. Commonly referred to as leuco cyan dye.

Possible Causes ?
Solutions ?

RA Bleach-Fix - High Replenishment / Low pH

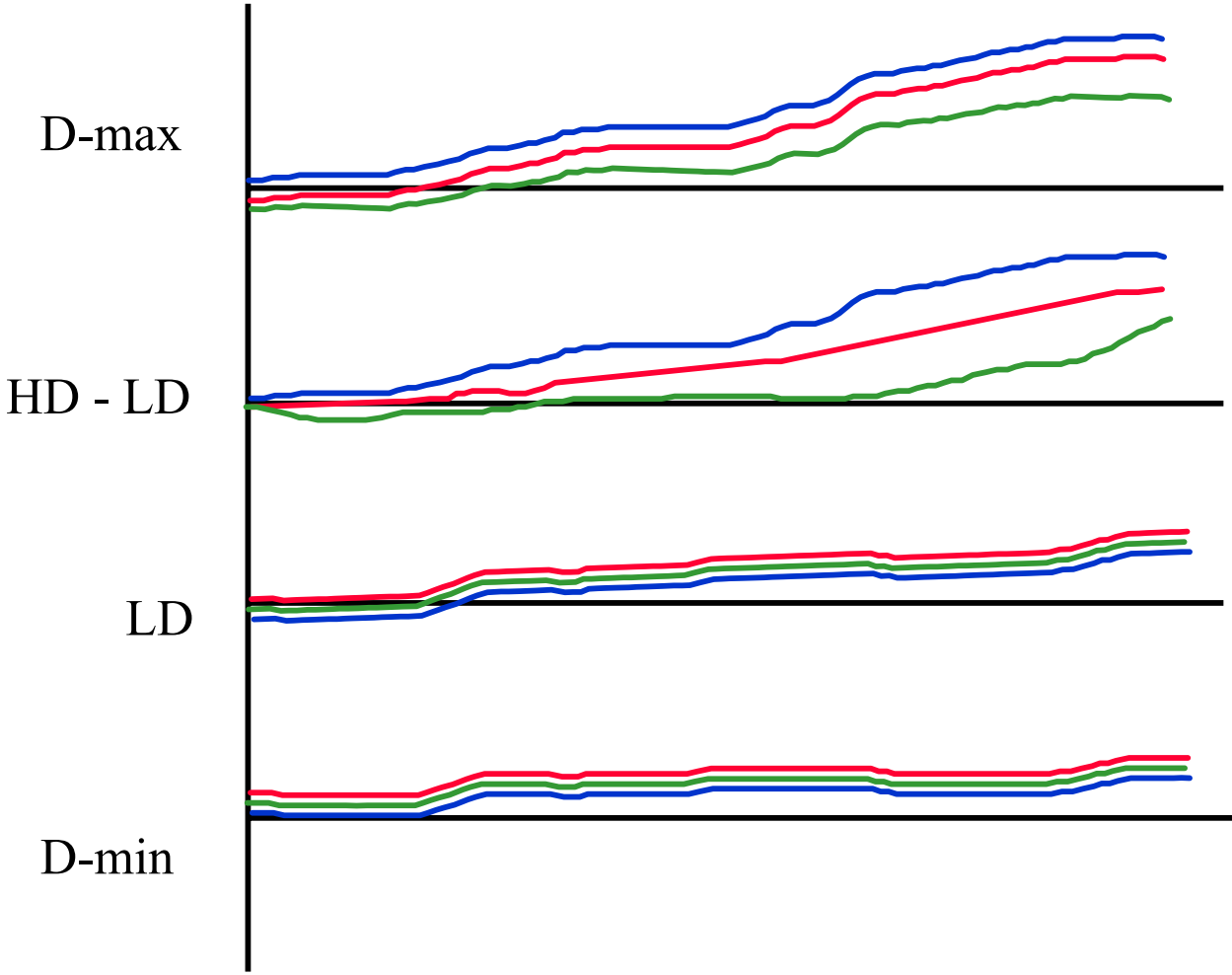
Possible Causes ?

- **Replenishment rate set too high.**
- **Replenishment system not calibrated.**
- **Replenishment system is passing chemistry during non-replenishment modes.**
- **Lane switch/sensor is activated at all times.**

Solutions !

- Make necessary corrections/repairs as to eliminate cause.

RA Bleach-Fix - Low Replenishment / High pH



Under replenishment of the bleach-fix will result in a high working tank pH and dilution from developer carry-in. This condition creates a poor "stop action" environment, subsequently increasing density and causing potential streaking problems.

In addition, the bleach-fix is unable to effectively remove silver from the paper. Primarily shows up as a muddy yellows and poor image contrast.

Possible Causes ?
Solutions ?

RA Bleach-Fix - Low Replenishment / High pH

Possible Causes ?

- **Replenishment rate set too low.**
- **Replenishment system not calibrated.**
- **Replenishment system is not replenishing during replenishment modes.**
- **Lane switch/sensor is not activated.**

Solutions !

- Make necessary corrections/repairs as to eliminate cause.

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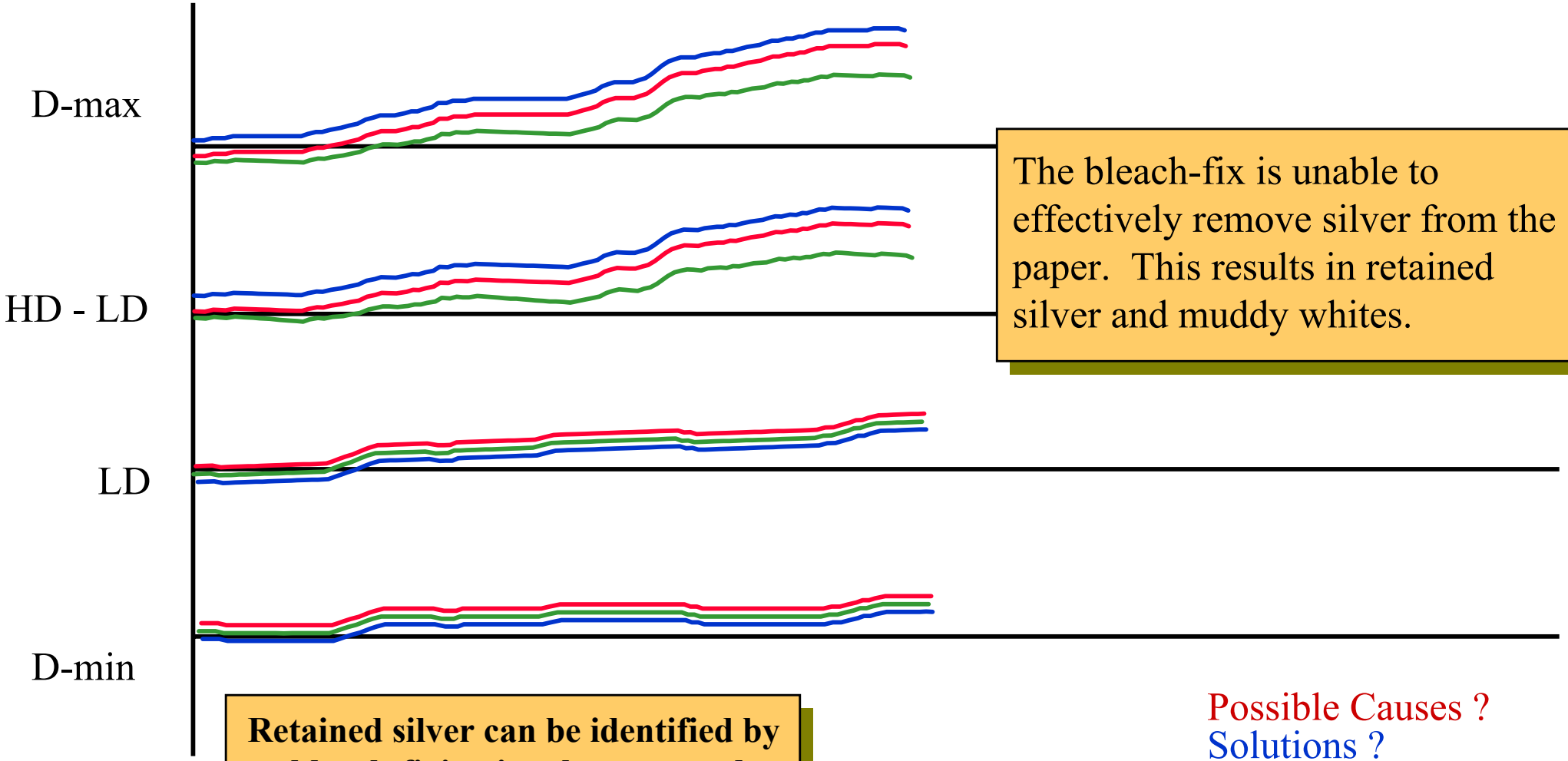
RA Bleach-Fix - Short Time



The bleach-fix is unable to effectively remove silver from the paper. This results in retained silver and muddy whites.

Retained silver can be identified by re-bleach-fixing in a known good solution or with an I.R. scope.

Possible Causes ?
Solutions ?

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RA Bleach-Fix - Short Time

Possible Causes ?

- **Machine is "short racked".**
- **Machine is not timed properly.**

Solutions !

- Make necessary corrections/repairs as to eliminate cause.

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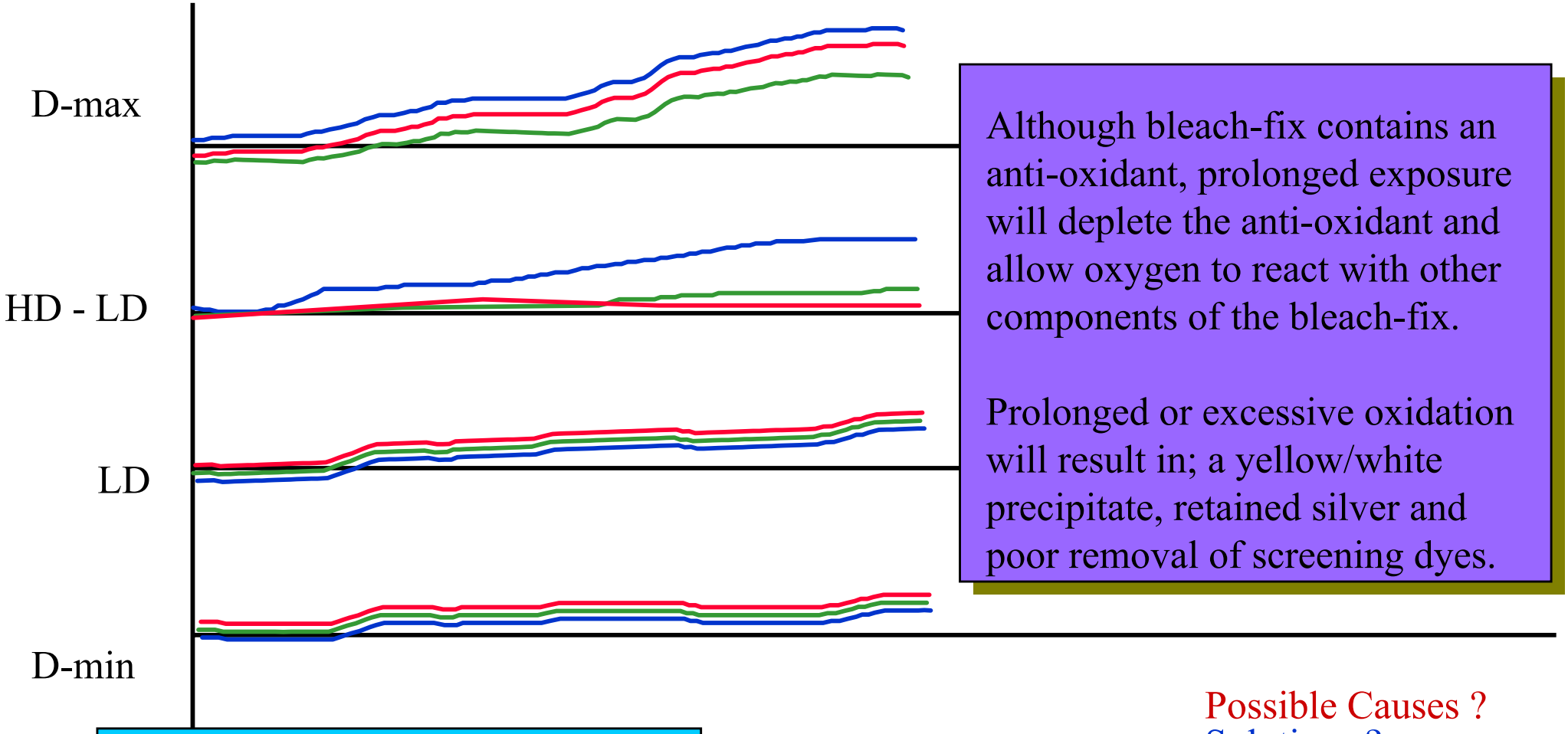
RA Bleach-Fix Oxidised



Although bleach-fix contains an anti-oxidant, prolonged exposure will deplete the anti-oxidant and allow oxygen to react with other components of the bleach-fix.

Prolonged or excessive oxidation will result in; a yellow/white precipitate, retained silver and poor removal of screening dyes.

Topping solution will minimize oxidation of a bleach-fix.

Possible Causes ?
Solutions ?

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RA Bleach-Fix Oxidised

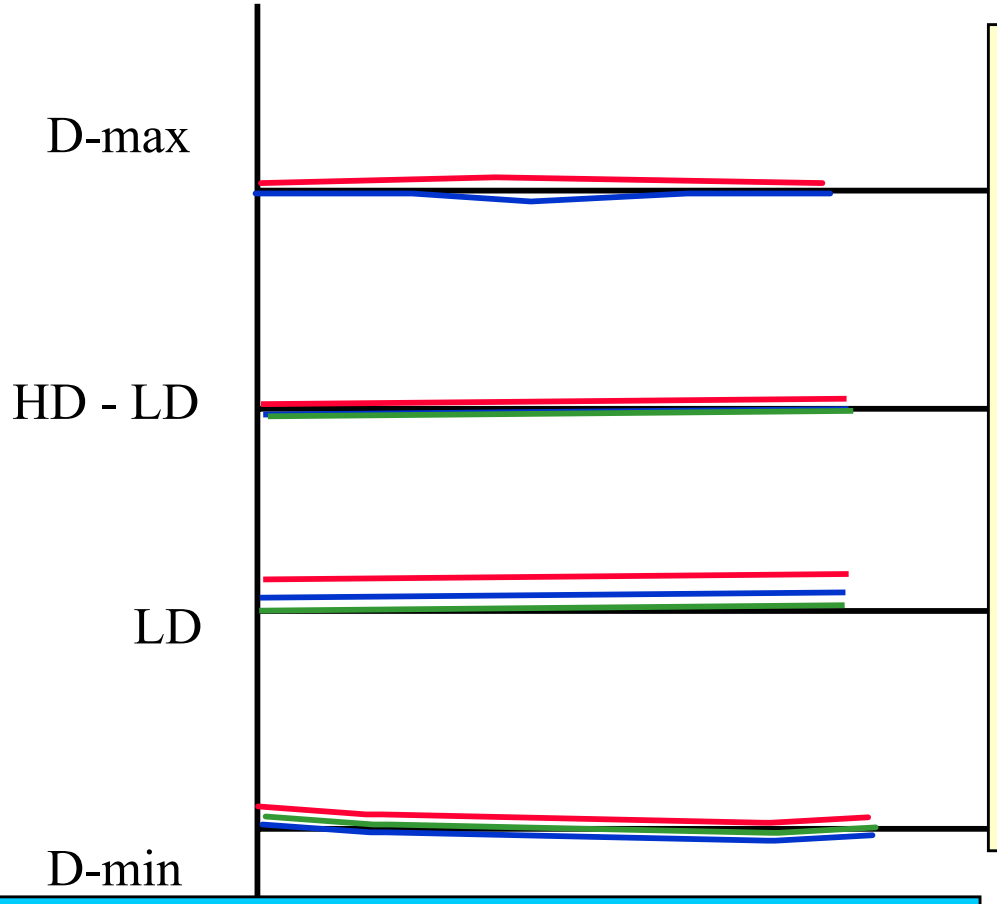
Possible Causes ?

- **Low utilization.**
- **Mechanical aeration from a leak in the circulation system.**

Solutions !

- Replace working tank solution.
- Make necessary corrections/repairs as to eliminate cause.
- Use a bleach-fix topping solution to prevent oxidation.

Trouble Shooting RA Print Rinse



Under normal conditions, the final rinse does not have a sensitometric effect.

"Dirty" rinse can cause a high D-min stain. This is usually caused by excessive bleach-fix carry-in or a low print rinse replenishment rate.

Fresh clean print rinse (or wash) is essential. Many labs replace their rinse (or wash) on a regular basis.

A wash process will always give better archival results.

The primary purpose of the final rinse is:

To remove residual bleach-fix and to stabilize the dye image

Possible Causes ?
Solutions ?

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Trouble Shooting RA Print Rinse

Possible Causes ?

- **Print Rinse is under replenished.**
- **Not changed frequently enough.**

Solutions !

- Change Print Rinse and possibly increase rate.