

THE GRAY COMPONENT REPLACEMENT - A NEW TREND IN COLOR REPRODUCTION

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GRAY COMPONENT REPLACEMENT (GCR) IS A NEW TREND BUT NOT A NEW IDEA. THE BASIC IDEA, A LONG-RANGE BLACK SEPARATION TO CONTROL COLOR PRINTING QUALITY WAS USED FOR MANY YEARS, ESPECIALLY IN LETTERPRESS.

MORE RECENTLY THE PROCESS HAS BEEN GIVEN A NUMBER OF DIFFERENT NAMES, BUT WAS MOST FREQUENTLY REFERRED TO AS ACHROMATIC. ACHROMATIC WAS THE TRANSLATION OF THE GERMAN WORD UNBUNT, MEANING WITHOUT COLOR. TO ADD TO THE CONFUSION, HOWEVER, EACH OF THE SCANNER MANUFACTURERS HAD DIFFERENT TERMINOLOGY FOR THIS SAME PROCESS. THEN SOME TERMS SUCH AS UCA (UNDER COLOR ADDITION), AND UCR (UNDER COLOR REMOVAL) WHICH ARE RELATED TO BUT NOT THE SAME AS GRAY COMPONENT REPLACEMENT, FURTHER INCREASED THE CONFUSION. FACED WITH THIS SITUATION, A YEAR AGO SEVERAL LEADERS IN THE U.S. PRINTING INDUSTRY DECIDED TO INTRODUCE A SINGLE TERMINOLOGY FOR THE PROCESS. GCR (GRAY COMPONENT REPLACEMENT) IS NOW THE OFFICIAL TERM IN THE U.S. FOR THIS PROCESS, WHICH IS EXPECTED TO IMPROVE THE QUALITY AND CONSISTENCY OF COLOR PRINTING.

WHAT IS GRAY COMPONENT REPLACEMENT? HOW DOES IT COMPARE WITH CONVENTIONAL COLOR REPRODUCTION (WHAT ARE THE DIFFERENCES, WHAT ARE THE POTENTIAL ADVANTAGES?) AND WHY A NEW TREND?

LET'S FIRST LOOK AT HOW COLOR IS PRINTED TODAY. MOST OF IT IS PRODUCED BY CONVENTIONAL COLOR SEPARATION METHODS, WHICH RELY ON COMBINATIONS OF THE THREE PRIMARY PRINTING INKS, YELLOW, MAGENTA AND CYAN, TO REPRODUCE MOST OF THE COLOR IN THE PRINTING PROCESS. CONVENTIONAL COLOR

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REPRODUCTION USES A SO-CALLED "SKELETON BLACK" PRINTER TO ADD EXTRA DEPTH AND NEUTRALITY IN THE DEEP SHADOW AREAS. THE BLACK HAS MINIMAL IMPACT IN TERMS OF COLOR.

WHILE CONVENTIONAL COLOR REPRODUCTION TECHNIQUES HAVE PROVIDED THE ABILITY TO PRODUCE A LOT OF GOOD QUALITY COLOR AND CERTAINLY WE NOW SEE MOST PRINTING PROCESSES USING COLOR EXTENSIVELY, THERE ARE SOME INHERENT CONTROL PROBLEMS IN THE PRINTING PROCESS. THESE ARE MOST TYPICALLY SEEN IN SOME OF THE MORE COMPLEX COLORS, FOR EXAMPLE, BROWNS, PURPLES, GREENS, DEEP REDS, FLESH TONES AND GRAYS. THESE ARE MORE DIFFICULT TO CONTROL IN PRINTING BECAUSE THEY ARE PRODUCED THROUGH A COMBINATION OF THE THREE COLORED INKS. A SLIGHT VARIATION IN ANY ONE INK RESULTS IN A NOTICEABLE HUE SHIFT.

TODAY WE CAN START TO LOOK AT A DIFFERENT WAY OF REPRODUCING COLOR THROUGH THE ADVENT OF ELECTRONIC COLOR SCANNERS. THROUGH THEIR COMPUTERS, SCANNERS PROVIDE US WITH THE ABILITY TO LOOK AT COLOR AND COLOR REPRODUCTION IN DIFFERENT WAYS. HENCE THE REEMERGENCE OF GRAY COMPONENT REPLACEMENT.

WHAT IS GRAY COMPONENT REPLACEMENT AND HOW DOES IT WORK? AS PREVIOUSLY STATED, WITH CONVENTIONAL COLOR SEPARATIONS, WE USE BASICALLY THE THREE-COLOR INKS TO PRODUCE MOST OF THE COLORS PRINTED. FOR EXAMPLE, WITH REDS PRODUCED BY A COMBINATION OF YELLOW AND MAGENTA INKS, THE CYAN INK IS USED TO DARKEN AND ADD SHAPE TO THE RED. WITH GREENS PRODUCED USING YELLOW AND CYAN, MAGENTA INK IS USED TO ADD DARKNESS AND SHAPE. WITH THE COMBINATION OF MAGENTA AND CYAN INKS PRODUCING A DEEP BLUE-PURPLE COLOR, THE COLOR THAT CONTAMINATES, DARKENS AND GIVES SHAPE IS THE YELLOW.

GRAY COMPONENT REPLACEMENT FOCUSES ON THOSE CONTAMINATING THIRD COLORS. WITH THE ROLE OF THE THIRD COLORS BEING TO PROVIDE DARKENING AND SHAPE, WHY USE COLORED INKS TO DO THAT? WHY NOT USE BLACK INK? THAT IN BASIC TERMS IS GCR! REPLACING THOSE CONTAMINATING THIRD COLORS WITH BLACK.

WHAT IS THE ADVANTAGE OF USING BLACK IN PLACE OF A COLOR? LET'S CONSIDER WHAT HAPPENS IN PRINTING A GREEN USING CONVENTIONAL COLOR SEPARATIONS. IF THE MAGENTA INCREASES IN VALUE DUE TO AN INCREASE IN DENSITY, OR DOT GAIN ON THE PRESS, THERE IS A HUE SHIFT IN THE GREEN. WITH GCR, THE COLOR VALUE IS STILL PROVIDED BY THE YELLOW AND CYAN BUT NOW THE DARKENING IS PROVIDED BY THE BLACK. IF THE BLACK INCREASES IN DENSITY OR DOT GAIN THERE IS STILL A CHANGE, BUT BECAUSE BLACK IS BEING ADDED TO THE COLOR VALUE AS OPPOSED TO MAGENTA, IT ONLY PRODUCES A DARKER SHADE OF THE SAME GREEN HUE. THAT TRANSLATES TO MORE CONSISTENCY AND LATITUDE WHEN PRINTING COLOR.

TAKE FOR EXAMPLE A TYPICAL IN-LINE SITUATION ON PRESS. ONE PICTURE HAS DEEP SATURATED REDS, WHILE THE IN-LINE PICTURE IS AN OUTDOOR SCENE WITH RICH GREEN GRASS AND DARK GREEN TREES IN THE BACKGROUND. WITH CONVENTIONAL COLOR, IF THE MAGENTA IS INCREASED TO IMPROVE THE SATURATED REDS, THE GREEN GRASS BECOMES OLIVE, AND THE DARK GREEN TREES BECOME BROWN ON THE ILLUSTRATION IN LINE. A COMPROMISE IS THEN REACHED ON THE REDS TO KEEP THE GRASS AND TREES GREEN.

USING THE SAME SCENARIO WITH GCR, AN INCREASE IN THE MAGENTA ON THE SATURATED REDS WILL HAVE NO EFFECT ON THE GREEN GRASS AND THE GREEN TREES. THAT TRANSLATES TO INCREASED LATITUDE AND CONSISTENCY IN PRINTING. THAT'S THE MAJOR BENEFIT OF GCR.

LET'S CONSIDER THE IMPACT OF GCR ON COLORS WHICH ARE TYPICALLY DIFFICULT TO CONTROL USING CONVENTIONAL SEPARATIONS. GRAYS ARE DIFFICULT TO CONTROL BECAUSE THEY ARE PRODUCED BY A DELICATE BALANCE OF THE THREE-COLORED INKS. WITH GCR, THE BLACK IS NOW USED TO PRODUCE THE NEUTRAL GRAY WITH COLOR ONLY ADDED TO PRODUCE ANY COLOR BIAS IN THE NEUTRAL.

BROWNS ARE ALSO DIFFICULT COLORS TO REPRODUCE CONSISTENTLY, FOR EXAMPLE, DEEP WOOD TONES. THE REASON IS THAT IN CONVENTIONAL COLOR, BROWN IS PRODUCED BY THE COMBINATION OF YELLOW AND MAGENTA WITH THE CYAN PROVIDING THE DARKENING AND SHAPE. IN GCR THE CYAN IS REPLACED BY BLACK. THERE IS ALSO A REDUCTION IN THE YELLOW AND MAGENTA BECAUSE A PERCENTAGE OF BOTH COMBINED WITH THE CYAN WAS ACTUALLY PRODUCING A GRAY COMPONENT IN THE COLOR. THE BLACK INK NOW PROVIDES THAT GRAY COMPONENT. THE RESULTING REDUCTION IN TOTAL INK LAYDOWN IN THE DARK BROWNS ALSO HELPS REDUCE INK TRAPPING AND DRYING PROBLEMS.

IN PURPLES, WHERE THE YELLOW PROVIDES THE DARKENING AND SHAPE IN CONVENTIONAL COLOR, IT IS CLEARLY MORE EFFICIENT TO USE BLACK INK. THAT'S EXACTLY WHAT HAPPENS WITH GCR.

GRAY COMPONENT REPLACEMENT CAN BE APPLIED IN VARIOUS DEGREES FROM 0% TO 100%. WITH 100% GCR YOU'RE LEFT WITH JUST THE VERY BASIC COLOR VALUE. ALL OF THE REST OF THE PICTURE IS MADE UP BY BLACK, OR THROUGH THE GRAY COMPONENT.

AT EACH OF THE VARIOUS LEVELS OF GCR, THE ADDITION OF THE BLACK WILL PRODUCE THE SAME COLOR. THE INDUSTRY HAS DETERMINED THAT IN MOST CASES THE 100% LEVEL OF GCR IS PROBABLY NOT DESIRABLE BECAUSE IT CAN CREATE SOME UNWANTED EFFECTS WHEN PRINTED. THIS IS DUE TO A LACK OF COLOR PRINTING UNDER THE BLACK AREAS WHICH CAN RESULT IN A LACK OF SATURATION AND

GLOSS ON DEEP BLACKS. THIS EFFECT HAS RESULTED IN YET ANOTHER NEW INDUSTRY TERMINOLOGY, UNDER COLOR ADDITION (UCA).

BEFORE DESCRIBING UCA LET'S FIRST CONSIDER UNDER COLOR REMOVAL (UCR), A TERM THAT MOST PEOPLE ARE MORE FAMILIAR WITH. UNDER COLOR REMOVAL HAS BEEN USED FOR A NUMBER OF YEARS IN RESPONSE TO CERTAIN LIMITATIONS IN THE PRINTING PROCESS. THESE INVOLVE THE AMOUNT OF EACH INK THAT CAN BE PRINTED WET ON WET, TRAPPED AND DRIED, ESPECIALLY IN SATURATED AREAS AND DARK SHADOWS. RECOGNIZING THESE LIMITATIONS UNDER COLOR REMOVAL REDUCES THE AMOUNT OF YELLOW, CYAN AND MAGENTA PRINTED IN THE NEUTRAL SHADOW AREAS. THIS IS ACCOMPLISHED AS AN AUTOMATIC FUNCTION, USING TODAY'S ELECTRONIC SCANNERS.

IN THE PUBLICATION INDUSTRY, THE NEW SWOP SPECIFICATIONS REQUIRE NO MORE THAN 300% TOTAL PRINTING AREA IN THE FOUR COLOR IMAGE IN DEEP SHADOW AREAS. THIS IS ACHIEVED BY USING UNDER COLOR REMOVAL (UCR) TO REDUCE THE THREE COLOR VALUE IN THE SHADOW AREAS. UCR IS PRIMARILY AFFECTING THE DEEP BLACK SHADOWS AND, WITH THE ADDITION OF BLACK, WE ACHIEVE CONTRAST AND GLOSS ON THE PRINTED RESULT.

A NEW TERM NOW BEING USED IN THE INDUSTRY IS UNDER COLOR ADDITION. WITH GRAY COMPONENT REPLACEMENT, THE GRAY FACTOR IS REMOVED FROM BOTH COLOR AND NEUTRAL AREAS. WHILE THERE IS A LIMIT IN HOW MUCH INK CAN BE PRINTED TO PRODUCE DEEP BLACK, THERE IS ALSO A LIMIT ON HOW LITTLE CAN BE PRINTED. IF THERE IS INSUFFICIENT COLOR UNDERLAYING THE BLACK INK IT DOESN'T HAVE SATURATION AND DEPTH. THEREFORE WITH GCR IT IS NECESSARY TO MAKE SURE THERE IS SUFFICIENT COLOR ADDED BACK TO PRODUCE A DEEP STRONG BLACK. THIS ADDITION OF YELLOW, MAGENTA AND CYAN UNDER THE DARK NEUTRALS IS CALLED UNDER COLOR ADDITION (UCA).

USING GCR THE THREE COLOR IMAGE LOOKS COMPLETELY DIFFERENT. THIS IS EASIEST TO SEE WHEN THE GCR AND CONVENTIONAL THREE COLOR IMAGES ARE COMPARED. THE GCR IMAGE LOOKS MORE LIKE A TWO COLOR PROGRESSIVE.

UNLIKE THE CONVENTIONAL SKELETON BLACK, THE GCR BLACK PROVIDES MUCH OF WHAT WAS PREVIOUSLY COLOR INFORMATION. IT ADDS SHAPE AND DETAIL THROUGHOUT THE COLOR IMAGE.

WHEN A CROMALIN® PROOF IS MADE THE COLOR IN THE GCR AND CONVENTIONAL SEPARATION WILL LOOK THE SAME. HOWEVER, THE CONVENTIONAL COLOR SEPARATION IS FAR MORE SENSITIVE TO FLUCTUATIONS DURING PRINTING.

IN SUMMARIZING THE DIFFERENCES BETWEEN PROCESSES, WE CAN STATE THAT WHILE CONVENTIONAL COLOR UTILIZES THE THREE COLORED INKS TO REPRODUCE COLORS, GCR REPLACES THE THIRD OR TERTIARY COLOR AND USES THE COMBINATION OF SINGLE AND TWO COLOR OVERPRINTS PLUS BLACK TO REPRODUCE COLORS.

THE USE OF GCR SEPARATIONS PROVIDES BOTH TECHNICAL AND ECONOMIC BENEFITS. TECHNICAL ADVANTAGES IN PRINTING INCLUDE LESS HUE SHIFTS AS A RESULT OF DOT GAIN AND DENSITY FLUCTUATIONS. WITH NEUTRAL GRAYS NOW PRODUCED PRIMARILY WITH BLACK THEY ARE MUCH MORE CONSISTENT, AND USING BLACK AS OPPOSED TO THE CONTAMINATING THIRD COLOR ACTUALLY INCREASES THE RANGE OF COLOR THAT CAN BE REPRODUCED. INK TRAPPING AND DRYING PROBLEMS ARE REDUCED AND MORE BRILLIANT COLORS CAN BE PRINTED BY INCREASING INK VOLUME IN SATURATED COLORS. GCR, ALSO PRODUCES SHARPER LOOKING IMAGES. NO LONGER IS EXACT REGISTRATION OF THE THREE-COLOR IMAGE REQUIRED TO PROVIDE THE SHARPNESS OF THE PICTURE BECAUSE NOW MOST OF THE DETAIL AND SHAPE IS PROVIDED BY THE BLACK PRINTER.

THESE TECHNICAL BENEFITS LEAD TO THE REAL DRIVING FORCE FOR GCR, ECONOMICS! THE REDUCED MAKEREADY TIMES TO ACHIEVE COLOR AND IMPROVED COLOR CONSISTENCY THROUGHOUT THE RUN WITH GCR RESULT IN IMPROVEMENTS IN PRODUCTIVITY AND REDUCTIONS IN WASTE. ALSO, WITH GCR IT IS POSSIBLE TO REPRODUCE VERY GOOD QUALITY COLOR ON LOWER GRADE PAPERS AND OTHER SUBSTRATES.

THESE ECONOMIC ADVANTAGES COMBINED WITH INCREASED QUALITY AND CONSISTENCY ARE THE REASON FOR THIS NEW TREND TO GCR.

WHAT ARE SOME OF THE CONCERNS TYPICALLY RAISED ABOUT CONVERTING TO GCR. FIRSTLY, OBVIOUSLY A LOT OF THE WORK ALREADY HELD IN FILE WILL BE CONVENTIONAL COLOR SEPARATIONS. WHAT HAPPENS WHEN GCR AND CONVENTIONAL SEPARATIONS ARE INTERMIXED ON THE SAME FORM. GCR STILL PROVIDES ALL OF THE BENEFITS IN TERMS OF PRINTING EVEN WHEN IT IS COMBINED TOGETHER WITH CONVENTIONAL COLOR. THE ADVANTAGE OF THE GRAY COMPONENT REPLACEMENT SEPARATION HAVING MORE LATITUDE, EASIER CONTROL AND EASIER ACHIEVEMENT OF COLOR ON PRESS, ENABLES THE CONVENTIONAL COLOR TO BE BROUGHT TO COLOR QUICKER.

CONTROL OF THE BLACK IN THE PRINTING PROCESS IS MORE CRITICAL WITH GRAY COMPONENT REPLACEMENT BECAUSE THE BLACK PRINTER IS NOW USED TO PRODUCE MUCH OF THE COLOR. IT IS IMPORTANT THAT THE BLACK PRINTING UNIT IS NOW GIVEN THE SAME ATTENTION AS THE COLOR UNIT.

FROM EXPERIENCE TO DATE COLOR ROTATION DOES NOT SEEM TO BE A FACTOR. GCR SEPARATIONS HAVE BEEN PRINTED USING EXISTING COLOR ROTATIONS WITH THE BENEFITS BEING REALIZED WHICHEVER ROTATION HAS BEEN USED.

MANY OF THE COLOR SCANNERS BEING USED TODAY CAN PRODUCE THIS TYPE OF COLOR SEPARATION, AND MOST OF THOSE WHICH CAN NOT, CAN BE UPGRADED WITH SOME COST TO PRODUCE THIS TYPE OF COLOR SEPARATION.

WHY IS DU PONT INVOLVED WITH GCR? CONSISTENT WITH DU PONT'S MAJOR COMMITMENT TO THE PRINTING INDUSTRY, WE HAVE BEEN WORKING TO DEVELOP METHODS TO EVALUATE AND QUANTIFY THE IMPACT OF GCR SO THAT USERS WILL BETTER UNDERSTAND IT'S APPLICATION. THIS INCLUDES DEVELOPMENT OF PRINTING TEST FORMS TO HELP BOTH PRINTER AND PRINT BUYER DEFINE HOW GCR CAN BENEFIT THEM.

THE USE OF THE CROMALIN® MASTERPROOF™ OFFPRESS PROOFING SYSTEMS FOR EITHER COMMERCIAL OR PUBLICATION PRINTING ENABLES TESTS AND EXPERIMENTS TO BE RUN TO ACHIEVE THE PROPER COLOR BALANCE OF THE GCR SEPARATIONS PRIOR TO COMMITTING TO THE PRODUCTION PRESS. THIS INCLUDES TESTING THE IMPACT OF CHANGES IN HUE OR DENSITY OF THE COLOR AND BLACK INKS TO ACHIEVE THE OPTIMUM COLOR QUALITY. THIS IS AN IMPORTANT FACTOR IN HELPING THE INDUSTRY PUT GCR TO WORK.

GCR IS A SYSTEM THAT CAN BE APPLIED IN OFFSET, GRAVURE, FLEXOGRAPHIC OR LETTER PRESS PRINTING. THE OVERALL IMPROVEMENT IN QUALITY AND PRODUCTIVITY FOR EACH PROCESS SHOULD LEAD TO THE MOST IMPORTANT IMPROVEMENT OF ALL. THE BOTTOM LINE.